

4.0 SECONDARY BASIN DESCRIPTIONS

The objectives of this phase of the Estero Bay Watershed characterization include description and compilation of relevant data on the Estero Bay Watershed, especially with respect to hydrology and major characteristics of the study area basins. Major characteristics include:

- ! topography,
- ! soils,
- ! vegetation,
- ! land use, and
- ! geologic and drainage features.

This chapter also presents a description of urban, agricultural, and water management practices in each of the secondary basins in the project area. Urban drainage and overall structural facilities for flood control and irrigation are described. An inventory and summary of permit information was compiled using the SFWMD's database permit information. In addition, the District's permit files were researched for additional information to map water management structures and direction of water flow in the watershed.

The Estero Bay Watershed is divided into eleven secondary basins for the purpose of this report:

- | | |
|---------------------------|-------------------|
| ! Ten-Mile Canal | ! Hendry Creek |
| ! Six-Mile Cypress Slough | ! Spring Creek |
| ! Mullock Creek | ! Corkscrew Swamp |
| ! Estero River | ! Lake Trafford |
| ! Imperial River | ! Barrier Islands |
| ! Cow Creek | |

4.1 Ten-Mile Canal

The Ten-Mile Canal Basin includes 8,717 acres in the northern portion of Lee County and drains the Ten-Mile Canal tributary to the northern portion of Estero Bay. The basin is bounded by Ten-Mile Canal on the west, which flows south to Mullock Creek where it empties into the bay. Alico Road forms the southern boundary of the basin east of S.R. 41, while the basin includes areas east of S.R. 41 to Mullock Creek. The basin is bounded to the north by Hanson Street and Six-Mile Cypress

Parkway to the east and is confined to the immediate area of Ten-Mile Canal south of Six-Mile Cypress Parkway to Alico Road.

The Ten-Mile Canal was excavated about 1920 to intercept sheetflow from 10 square miles of the Six-Mile Cypress Slough Basin and waters south to Mullock Creek and Estero Bay (State of the Bay, 1998). This opened lands west of the canal to farming. As the economic climate changed, residential, commercial, industrial and institutional development replaced gladiolus farms.

Ten-Mile Canal was originally a linear drainage conveyance with no control structures. As a result, the canal was either dry or overflowing, depending on the season. In 1975, Lee County undertook a flood mitigation project to widen and deepen the canal and provide three water control structures; the largest conveying 2,500 cfs. Concurrently, four structures were installed in Six-Mile Cypress to regulate levels and outflows in this tributary. The canal was operational and nearly complete in 1977 and now holds water year round.

4.1.1 Topography

Elevations in the Ten-Mile Canal Basin generally increase from the 5 foot contour along S.R. 41 in the southwest up to 15 feet in the northern portion of the basin and slopes approximately 1 foot per mile. Only a small area in the southernmost portion of the basin which flows east of Ten-Mile Drive and flows directly into Mullock Creek lies below the 5 foot contour. The upper portion of the basin lies within the incorporated area of the City of Fort Myers.

4.1.2 Soils

Soils in the Ten-Mile Canal Basin generally consist of level layers of uniform fine sand or silty sand, varying in thickness from six inches to forty inches or more. Hallandale-Boca soils, characteristic of flatwoods and sloughs, dominate the Ten-Mile Canal Basin. These soils are nearly level, poorly drained, shallow to deep sandy soils and sandier and more shallow than the Immokalee-Myakka soils farther west.

In general, these soils are composed of the coastal Holocene sediments and undifferentiated shell beds in the interior portion of the Estero Bay Watershed. Anthropogenically altered or arent soils, e.g., dredge and fill, shell mounds, and landfills also occur in the basin.

Nearly all the individual soils series within the 8,510 acres of mapped soils in the basin have been defined as HSG D and total 8,327 (Plate 4-1 and Table 4-1). HSG D soils have very slow infiltration rates when thoroughly wetted, thus, the runoff within the basin is expected to be high. These soils are primarily clay with a high permanent water table or shallow soils over nearly impervious materials, such as a clay pan or clay layer. The small area of HSG C soils are located in the

southernmost portion of the basin and appear to be associated with spoil disposal around the large artificial lakes just north of Mullock Creek.

Table 4-1. Hydrologic soil groups in the Ten-Mile Canal Basin.		
HYDROLOGIC SOIL GROUP	AREA (acres)	PERCENT COVER
A	0	0%
B	0	0%
C	183	2%
D	8,327	98%
TOTAL	8,510	100%

4.1.3 Existing Land Use

Existing land use acreages for the Ten-Mile Canal Basin are presented in Table 4-2. A map of existing land use for the basin is presented in Plate 4-2. Land use in the Ten-Mile Canal Basin includes almost 60% developed lands (urban and agriculture land uses). Residential areas make up 15% of the overall land use in the basin, including predominantly low density (525 acres) and medium density (458 acres) residential. The larger residential communities are located in Fort Myers (City View Park community), and others along the east side of Metro Parkway, including Plantation Pines, Deer Run, and Highland Pines. Mobile homes and high density residential together make up only 4% of the basin land use and are scattered throughout the basin.

Recreation land use makes up 10% (835 acres) of the basin land use. Recreation land use in the basin is associated with golf and country clubs, such as The Forest and Eastwood communities. Agriculture is the largest developed land use in the basin and crop and pasture lands make up nearly 20% (1,660 acres) of the land use in the Ten-Mile Canal Basin.

Commercial/industrial and transportation land uses combined compose 9% (802 acres) of the Ten-Mile Canal Basin, more than in any of the other secondary basins. Transportation and utilities make up the smallest land use category and are primarily associated with S.R. 41, Colonial Blvd., Metro Parkway, and several other major roadways in the basin.

Less than 40% of the Ten-Mile Canal Basin (3,175 acres) is classified as undeveloped, and approximately a quarter of the total basin land use is in upland forest, mostly pine (coniferous). Upland pine forests make up 1,733 acres (20%) and occur throughout those portions of the basin north of Alico Road.

Wetland forested areas cover only 11% of the basin overall (963 acres) and include areas of wetland hardwoods (388 acres) over 4% of the basin, as well as cypress wetlands (513 acres) over another 6% of the basin. Both these classes occur along the sloughs and creeks in the basin.

Water occurs primarily as reservoirs (202 acres) and streams and waterways (146 acres) and composes only 348 acres (4%) of the basin. Water in this basin is primarily associated with canals and drainage impoundments scattered throughout the basin. These areas result in the discrepancy in total acres between soils and land use as a result of the area being designated as water in the soils map and disturbed land on the land use map.

Table 4-2. Land use and land cover for the Ten-Mile Canal Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Residential		
Residential Low Density	525	1%
Residential Medium Density	458	6%
Residential High Density	243	5%
Residential - Mobile Homes	58	3%
Subtotal	1,284	15%
Commercial/Industrial		
Commercial and Services	157	2%
Industrial	645	7%
Institutional	52	1%
Subtotal	852	10%
Barren Land		
Disturbed Lands	180	2%
Subtotal	180	2%
Recreation and Open Land		
Recreational	246	3%
Open Land	589	7%
Subtotal	835	10%
Transportation and Utilities		
Transportation	304	3%
Utilities	43	<1%
Subtotal	347	3%
Agriculture		
Cropland and Pastureland	1,660	19%
Specialty Farms	34	<1%

Table 4-2. Land use and land cover for the Ten-Mile Canal Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Subtotal	1,694	19%
TOTAL DEVELOPED LANDS	5,194	59%
Upland Forested		
Upland Coniferous Forests	1,733	20%
Upland Hardwood Forests	330	4%
Subtotal	1,040	15%
Shrub and Brushland	149	2%
Wetlands		
Wetland Coniferous Forests	513	6%
Wetland Hardwood Forests	388	4%
Vegetated Non-Forested Wetlands	46	1%
Wetland Forested Mixed	16	<1%
Subtotal	963	11%
TOTAL UNDEVELOPED LANDS	3,175	36%
Water		
Streams and Waterways	146	2%
Reservoirs	202	2%
Subtotal	348	4%
TOTAL	8,717	100%

4.1.4 Geologic and Drainage Features

The Ten-Mile Canal Basin is characterized by surface and subsurface drainage features that interact with each other. There is a network of canals in the basin which provide stormwater and groundwater drainage for agricultural and residential areas, which make up nearly 20% and 15%, respectively, of the basin land use. Only 11% of the basin includes undeveloped wetlands. The existing geologic and drainage systems are discussed in the following sections.

4.1.4.1 Hydrogeology

There are three major aquifer systems underlying the Estero Bay Watershed, including the Ten-Mile Canal Basin. These are the:

- ! Surficial Aquifer System,
- ! Intermediate Aquifer System, and
- ! Floridan Aquifer System.

The Surficial Aquifer is the uppermost aquifer and includes the water table aquifer, confining beds, and the lower Tamiami aquifer; the water table aquifer and the lower Tamiami aquifer are the two main water-bearing formations. The water table aquifer is an unconfined aquifer of primarily undifferentiated sands, shell beds, calcareous clays, and some limestone. The semi-confining Tamiami confining zone separates the water table aquifer from the Lower Tamiami Aquifer.

The Surficial Aquifer is the most significant aquifer system since it is the closest to the surface and is at times in direct connection with surface water. The potentiometric surface of this aquifer follows land surface contours and for undrained areas, wet season water levels are seldom less than 3 feet above or below land surface. The water level in the Surficial Aquifer in the Ten-Mile Canal Basin ranges from 4 feet NGVD in the western and southern portions of the basin to approximately 12 feet NGVD along the northeastern watershed boundary (SFWMD, 1990).

Thickness of the aquifer varies between 25 and 50 feet in central Lee County to and thickens toward the southeastern part of Lee County. Movement in the Surficial Aquifer is generally southwest and provides water for baseflow for major streams and rivers in the watershed.

In areas where the underlying Hawthorn confining zone is thin or absent the surficial aquifer is in direct hydraulic connection with the Sandstone aquifer. The upper Hawthorn confining zone separates the Surficial Aquifer from the Sandstone Aquifer in most of Lee County and ranges from 0 to 25 feet below the surface in the central portion of the watershed and the thickness decreases farther south and is absent near Bonita Springs.

The Intermediate Aquifer, also called the Hawthorn Aquifer, lies below the Surficial Aquifer and is comprised of the five major units listed below. The two water producing zones of this system are the Sandstone and Mid-Hawthorn aquifers (SFWMD, 1982).

- ! Upper Hawthorn Confining Zone,
- ! Sandstone Aquifer,
- ! Mid-Hawthorn Confining Zone,
- ! Mid-Hawthorn Aquifer, and
- ! Lower Hawthorn/Tampa Confining Zone.

The Floridan Aquifer underlies all of Florida. The top of the Floridan Aquifer is associated with the lower Hawthorn Formation and the Tampa Formation, the top of which ranges from -350 feet in northwestern Lee County to -700 feet in the southern portion of the county. The potentiometric surface of the Mid-Hawthorne Aquifer ranges from 0 feet NGVD along the canal in the Ten-Mile Canal Basin to approximately 20 feet NGVD along the eastern boundary.

The Sandstone Aquifer underlies the upper Hawthorn confining zone throughout nearly the entire watershed. The top of this unit occurs between 10 to 15 feet NGVD from the coastal areas to the

northeastern boundary in the Ten-Mile Canal Basin in Lee County (SFWMD, 1990). In the northern part of the Estero Bay Watershed it is between 25 and 50 feet NGVD, but it dips in a southerly direction to 150 feet below the surface in the southeastern portion of Lee County.

The Tamiami and Hawthorn formations are approximately 40-580 feet in thickness in Lee County. These formations occur as limestones and dolomites and serve as reservoirs for the Tamiami and upper Hawthorn aquifers which supply freshwater. The lower Hawthorn Aquifer water supply is highly saline (SWRPC, 1995).

4.1.4.2 Surface Drainage

Surface drainage is dependent on groundwater levels, rainfall, and the drainage network characteristics. Groundwater inflows and rainfall are inputs to the surface water hydrologic system, whereas the drainage network controls the output. The primary conveyance in the Ten-Mile Canal Basin is Ten-Mile Canal, which empties near the mouth of Mullock Creek before flowing into northern Estero Bay.

Ten-Mile Canal is the receiving waterbody for surface water flows west of Six-Mile Cypress Slough. Flows in the basin generally follow major roadways west to Ten-Mile Canal and then flow south. Below its intersection with Six-Mile Cypress Slough, the canal receives flow from the Six-Mile Cypress Slough and then flows south under US 41 and into Mullock Creek. South of US 41, the basin opens up again and receives surface water runoff from the area west of US 41 to Island Park road before emptying into Mullock Creek.

4.1.5 Management Practices

Approximately 59% of the Ten-Mile Canal Basin is classified as urban and agricultural lands (Table 4-2). The urbanized areas of the basin are dispersed throughout the basin. The discussion of urban management practices is divided into urban water uses and urban water discharges. The water uses and water discharges are listed in the following descriptions.

4.1.5.1 Urban Management Practices

Urban land uses in the Ten-Mile Canal Basin compose 3,500 acres (40%) of the basin. Urban land uses include 15% residential and 10% recreation and open space. Water use and surface water management permits within the basin have been issued for three general areas: North Colonial Canal, west of the Ten-Mile Canal, and the remainder of the basin. Permitted activities are primarily for residential and commercial uses in the basin.

Table 4-3 lists the surface water discharges permitted in the basin. No permits for withdrawals were found. Accordingly, water management features are summarized below. Information was obtained from SFWMD permit files.

Table 4-3. Surface water discharges (cfs) permitted in the Ten-Mile Canal Basin.		
PERMIT NUMBER	ACRES SERVED	PERMITTED ANNUAL DISCHARGE
<i>36-00561-S</i>	9.31	0.5 cfs
<i>36-01173-S</i>	11.37	1.9 cfs
<i>36-00540-S</i>	2,500	145 cfs
<i>36-00560-S</i>	335.6	19 cfs
<i>36-00632-S</i>	6.37	6 cfs
<i>36-00147-S</i>	108.9	34 cfs
<i>36-00242-S</i>	320	104 cfs
<i>36-00258-S</i>	17.5	17.5 cfs
<i>36-00336-S</i>	6.63	3 cfs
<i>36-00348-S</i>	2.02	7.9 cfs
<i>36-00357-S</i>	10.0	2 cfs
<i>36-00436-S</i>	54.8	5 cfs
<i>36-00460-S</i>	66.23	22 cfs
<i>36-00551-S</i>	11.4	4 cfs
<i>36-00555-S</i>	5.68	2 cfs
<i>36-00590-S</i>	34.93	7 cfs
<i>36-00602-S</i>	174.1	17 cfs
<i>36-00726-S</i>	30.14	3 cfs
<i>36-01176-S</i>	3.41	0.68 cfs
<i>36-01499-S</i>	99.9	7 cfs

Water use and surface water management permits for the North Colonial Canal Area within the basin have been issued as follows:

SFWMD Permit No. 36-00561-S is issued to Cynwyd Investments for construction of Cynwyd Industrial Park, Phase III. The development is located on the south-central boundary of S30/T44S/R25E, northeast of Fort Myers. This phase of the project encompasses approximately nine acres. Drainage of stormwater is routed to Ten-Mile Canal via the North Colonial Waterway Ditch. The permitted discharge structure contains an inlet with a grate at elevation 17.53 feet NGVD and a 1-3-inch orifice with an invert elevation of 13.5 feet NGVD. The discharge culvert consists of 20 LF of 19-inch x 30-inch ERCP pipe.

SFWMD Permit No. 36-01173-S is issued to Fort Myers Lumber Company for an addition to its operation in Cape Coral. This permit pertains to 1.04 acres of the total land area, or 11.37 acres. The project is situated in S30/T44S/R25E. Runoff is routed to Ten-Mile Canal via an existing drainage ditch. Three control structures are permitted, all 2.0-inch weirs with the crest at elevations 16.71 feet, 16.32 feet, and 16.72 feet. Water quality monitoring is required.

SFWMD Permit No. 36-01612-S is issued to Colonial Properties to modify specific condition No. 1, lowering the finish floor elevation from 20.0 feet NGVD to 19.1 feet NGVD. The project is located southeast of Fort Myers in S31/T44S/R25E. The 259.4-acre mixed-use development discharges, through one control structure, to Ten-Mile Canal via North Colonial Waterway. Each phase of the development includes swales and culverts which route runoff into the existing master storm water management system which encompasses 47.8 acres of the total land area.

SFWMD Permit No. 36-00540-S authorizes the City of Fort Myers to construct and operate new canals in Sections 29 through 32/T44S/R25E. It also authorizes improvements in the east-west ditch, from Ten-Mile Canal to the northwest corner of S32, and three control structures discharging into the Ten-Mile Canal. The new east-west canal is permitted from the northeast corner of S31 to the northeast corner of Section 32. The new north-south canal extends from the northeast corner of S30 to the Colonial Boulevard Extension. Control structure locations are immediately east of the SCL Railroad (western), close to the NE corner of S21(eastern), and at the southwest corner of S28, Eastwood Golf Course. Control elevations are 13.5 feet NGVD, 15.0 feet NGVD, and 16.5 feet, respectively. The structures drain to Ten-Mile Canal.

SFWMD Permit No. 36-00560-S (supersedes PN 36-00368-S for Eastwood Golf Course) is issued to Cypress Trace Properties, Inc. for the construction and operation of a water management system, clubhouse and Phase I of a residential development entitled Cypress Trace. The project is located in S29/44S/25E, southeast of Fort Myers, and contains a total land area of 335.6 acres, including Eastwood Golf Course. The project area is 29.73 acres and includes two basins: the East Basin that has been previously permitted (*PN 36-00540-S*), and the West Basin. Discharge facilities in the East Basin include one 25-feet wide fixed crest weir with a crest at elevation 16.5 feet NGVD and two 4-inch x 5-inch bottom-opening sluice gates with inverts at elevation 10.0 feet NGVD. Discharge facilities in the West Basin include one modified type “C” inlet with a grate at elevation 19.5 feet NGVD, one 10-inch diameter orifice with an invert at elevation 15.5 feet NGVD and a length of 15-

inch diameter RCP culvert. Surface water discharge is routed to the North Colonial Waterway to Ten-Mile Canal.

SFWMD Permit No. 36-00632-S is issued to Harvey Youngquist (Granada Lake Center) for the construction and operation of a water management system and commercial development. The project is located in S7/T46S/R25E, along US 41 in Lee County and includes a total land area of 6.37 acres, of which 1.43 is for surface water management. Discharge facilities include a system of inlets and culverts direct runoff into a 0.04 acre dry retention area which overflows into Granada lake. The lake outfall structure consists of 1 - 2.4" wide weir with crest at elevation 6.5' NGVD and 1 - 110 degree v-notch bleeder with invert at elevation 6.0' NGVD. Discharge is routed via 210 LF of 18" diameter RCP culvert to the existing US 41 drainage ditch and eventually into Ten-Mile Canal. Permitted discharge is 6 cfs.

SFWMD Permit No. 36-00602-S is issued to The Harborage Development Co., Inc. for the construction and operation of a water management system serving 174.1 acres of residential lands discharging into the Ten-Mile Canal. The project is located in Lee County, S7/T46S/R25E. Runoff is directed to an on-site 106.5 acre lake via catch basins and culverts. Discharge facilities include 1 - 4.5' wide weir (as a bleeder) with crest at 2.0' NGVD and 240 LF of 19" x 3" RCP culvert draining into Ten-Mile Canal. Permitted discharge is 17 cfs.

SFWMD Permit No. 36-00436-S is issued to C.M. Symonds, Jr. for the construction and operation of a 24.0 acres water management system serving 54.8 acres of recreational lands by roadside swales, catch basins, stormwater culverts, an on-site lake, and culverts and swales. The project site is located in Lee County, S27/T45S/R25E, and will serve Indian Paint Travel Park. Discharge facilities include 1 -12" diameter circular orifice, 1 - 25 LF x 24" diameter CMP culvert and spreader swale discharging via overland sheetflow into Six-Mile Cypress to Ten-Mile Canal. The site also includes a 22.5 acre borrow area remaining from I-75 construction, along the east side of the cite. Permitted discharge is 5 cfs.

SFWMD Permit No. 36-00426-S is issued to L. Reynaude (trustee) for the construction and operation of a water management system and multi-family development, Timberwood Village. The project is located in Lee County, S1/T46S/R24E. The total project area includes 24.25 acres, of which 2.3 acres are water management, with a 2.05 acre lake. Discharge from the lake to the Canal is through a control structure at the east end of the lake, consisting of 1 - 4.5' wide weir with crest at 7.6' NGVD, 1 - 0.83' wide x 1.4' high triangular orifice with an invert at 3.4' NGVD; 362 LF of 18" diameter CMP culvert and approximately 25 LF of 36" - 30" composite pipe.

SFWMD Permit No. 36-00195-S is issued to Island Park Corporation (Island Park Woodlands) for the construction and operation of a water management system serving 61.7 acres of residential lands by a system of swales and culverts, a 6.3 acre retention area, 2 grassed berms, 2 culvert crossings, and 1 - 6" bleeder pipe discharging via the north swale adjacent to park Road into Ten-Mile Canal

and then Estero Bay. The total project area includes 70.3 acres and is located south of Fort Myers, S12/T46S/R24E. Discharge facilities include 2 culvert crossings under Island Park Blvd. with sodded berms and crest elevation at 2.5' NGVD, and a 6" PVC pipe at 1.5' NGVD through the berm. Water quality monitoring is required.

SFWMD Permit No. 36-00147-S is issued to Swor and Santini, Inc. (Briar Ridge) for the construction and operation of a water management system serving 108.9 acres of residential lands (48 single family units) by grassed swales, 25' wide perimeter grassed drainage easement, 50' wide backlot drainage easements, and 2 - 4' flashboard risers discharging into Ten-Mile Canal via a roadside ditch. The property is located in Lee County, S32/T45S/R25E. Discharge facilities include 2 - 4' long flashboard risers discharging through 40' - 30" RCP into a roadside drainage ditch. Bleeder slots (1.5") set at control elevation of 14.0' NGVD on the west structure and 14.5' NGVD on the east structure. Permitted discharge is 34 cfs.

SFWMD Permit No. 36-00064-S is issued to Swor and Santini, Inc. (The Woods) for the construction and operation of a water management system serving 80.3 acres of single family residential lands by overflow and roadside swales, 1 - 18" RCP drainage canal discharging into Ten-Mile Canal. The property is located in Lee County, S32/T45S/R25E.

SFWMD Permit No. 36-00261-S/W is issued to Fiddlesticks Ltd. (Fiddlesticks Country Club) for the construction and operation of a water management system serving 703 acres of residential and recreational lands discharging into Ten-Mile Canal. The property is located at S32-33/T45S/R25E. Discharge facilities include 1 - 3.6' wide weir with crest elevation 15.6' NGVD and 1 - 2.0' x 0.6' bleeder at elevation 15.8 NGVD. The project includes a 94.0 acre lake.

SFWMD Permit No. 36-00555-S is issued to Alico Self Storage Units for a system of inlets and culverts to direct flow to a 0.28 acre dry detention area. Discharge from the detention area will be to Granada Lake through a control structure consisting of a 6" diameter bleeder with an invert at elevation 5.0 NGVD and 20 LF of 19" x 30" RCP culvert. The total project area is 5.68 acres of commercial lands and is located at S7/T45S/R25E. Permitted discharge is 2 cfs.

SFWMD Permit No. 36-00460-S is issued to Lee County Industrial Park for a water management system to serve 66.23 acres of commercial and industrial lands. The applicant owns 10.8 acres of the park area, located in Lee County at S1/T46S/R24E. Existing facilities drain a 66.23 acre industrial park to an on-site 0.6 acre lake. Discharge facilities include 1 - 1.8' wide weir with crest at 6.5' NGVD, 1 - 1.1' wide, 25" v-notch bleeder with crest at 4.0' NGVD, and 20 LF of 24" diameter CMP culvert to a perimeter swale. The swale flows west along the south property boundary to a roadside ditch along US 41 and into Ten-Mile Canal. Permitted discharge is 22 cfs.

SFWMD Permit No. 36-01178-S is issued to Lee County for the replacement of 2 control structures at the interface of Six-Mile Cypress and Ten-Mile Canal. The project is located at S30, 1/

T45S/R25E. Discharge facilities include two weirs with total length of 210' with crest at elevation 11.0 NGVD and 4 - 6. X 5' operable slide gates.

SFWMD Permit No. 36-00551-S is issued to Island Park Shopping Center for the construction and operation of a water management system serving an 11.4 acre shopping center. The project is located in S1/T46S/R24E. Existing facilities include the US 41 roadside sale adjacent to the east side of the site, and Ten-Mile Canal, south of the property. Discharge facilities consist of drop inlets and stormwater piping to direct runoff to an exfiltration trench. The trench is 5270 LF of 18" diameter perforated CMP with an invert at elevation 4.0' NGVD in a 3' x 3' trench. Overflow from the trench will be through a control structure located in the southeast corner of the project site. The control structure consists of 1 - 1.25" high x 1.0' wide triangular orifice with an invert at elevation 6.0' NGVD and 44 LF of 18" diameter RCP culvert. The water then flows to the US 41 swale and flows south to Ten-Mile Canal. Permitted discharge is 4 cfs.

SFWMD Permit No. 36-00159-S is issued to the Lee County Board of County Commissioners for the construction and operation of a water management system for the improvement of 4.7 miles of Daniels Road by paving existing earthen roadway, 2 weirs, 2 bridge crossings, 1 mile long ditch, cross drains, swales and 1 gated box culvert discharging via overland flow into Ten-Mile Canal. Discharge facilities include 1 - 92' long and 1 - 48' long weirs with crest elevations at 15.0' NGVD. The culvert will have an invert elevation of 8.0 ' with a gate and overflow elevation of 18.0'.

SFWMD Permit No. 36-01499-S is issued to David Cassilly (The Sanctuary) for the construction and operation of a water management system serving 99.9 acres of residential lands discharging into Ten-Mile Canal. The property is located at S8/T45S/R25E. Discharge facilities include 1 - 1.2' wide weir with crest elevation at 15.74' NGVD, 1 - 136 degree v-notch bleeder with an invert at elevation 15.5' NGVD. The water management system will direct runoff to 26.5 acres of detention, which includes 24 acres of cypress wetlands. Permitted discharge is 7 cfs.

SFWMD Permit No. 36-00590-S is issued to Peter Santo for the construction and operation of a water management system serving 34.93 acres of commercial lands. The project site is located in S7/T45S/R25E. Discharge facilities include 920 LF of 13.5 wide and 4650' of 17.5' wide dry retention area. Discharge is via 1 - 0.9' wide by 1.3' high horizontal rectangular notch with an invert at elevation 15.0' and 1 - 3" diameter PVC bleeder with an invert at elevation 12.5' NGVD to the existing drainage easement along Metro Parkway. Permitted discharge is 7 cfs.

SFWMD Permit No. 36-00348-S is issued to MGM Enterprises for the modification to an existing surface water management system serving 2.02 acres of industrial development know as Southwest Pipe and Supply Building. The project is located in S18/T45S/R25E. The modification is for the operation and construction of dry pretreatment swales which route stormwater to the existing master surface water management system. The existing system drains 89 additional acres via roadside swales to the discharge point. Discharge facilities include 1 - 1.0' wide, 23 degree v-notch weir with

crest at elevation 14.5' NGVD. The outfall is an existing ditch which runs approximately 130 LF to Ten-Mile Canal. Permitted discharge is 7.9 cfs.

SFWMD Permit No. 36-00242-S is issued to D. Adams (Metro Park) for the construction and operation of a water management system serving 320 acres of industrial lands discharging into Ten-Mile Canal. The property is located in S31/T44S/R25E. Discharge facilities include 2 - 72" diameter RCP culverts; 1 - 7.0' wide weir with crest at elevation 14.0' NGVD; and 1 - 1 square foot v-notch bleeder with invert at elevation 13.0' NGVD. The facility includes a 43.2 acre lake and approximately 640 acres of off-site land will be drained through the facility. Permitted discharge is 104 cfs.

SFWMD Permit No. 36-00336-S is issued to Robb and Stucky Distribution Center for the operation of a surface water management system serving 6.63 acres of a 6.82 acre project site. The project is located in S7/T45S/R25E. Discharge facilities include a system of swales which direct runoff to a 0.82 acre dry detention pond with 1 - 8.1' wide weir with crest elevation 15.5' NGVD and 1 - 3" diam. PVC bleeder with invert at elevation 13.1' NGVD control structures. Permitted discharge is 3 cfs.

SFWMD Permit No. 36-00726-S is issued to The Rookery for the construction of a surface water management system serving a 30.14 acre single family development. The total project area is 39.9 acres and is located in S18/T45S/R25E. The system includes swales, catch basins and storm drains directing runoff to a 2.5 acre lake. Discharge facilities include a 28" x 36" overflow inlet with a top at elevation 17.0' NGVD and 1 - 10" wide by 12" high inverted triangular bleeder with an invert at 14.0' NGVD. Discharge is into the Plantation road ditch with eventual discharge into Ten-Mile Canal. Permitted discharge is 3 cfs.

SFWMD Permit No. 36-00760-S is issued to Full Service Storage for a modification to increase the water management area of a previously approved water management system serving 12.68 acres of industrial lands, known as Full Service Storage, by 0.36 acres. The project is located in S6/T46S/R25E. The total project area is 12.68 acres with a total of 3.05 acres of water management. Discharge facilities consist of 1 - 4.5" diameter circular orifice with invert at elevation 7.15' NGVD and 20 LF of 12" diameter RCP culvert discharging into Ten-Mile Canal via existing ditches and swales. Water quality monitoring is required.

SFWMD Permit No. 36-00615-S is issued to Brookshire Bath and Tennis Club, Inc. for the construction and operation of a water management system serving 116.66 acres of residential, commercial, and recreational lands discharging via an existing county ditch into Ten-Mile Canal. The project is located in S19/T45S/R25E. The total project area is 143.55 acres, consisting of permitted phase I (116.66 acres), phase II (14.1 acres), and the only tract not yet permitted is phase III - the 11.79 acre commercial project. The modification of the permit was issued to lower the control elevation from 13.0' NGVD to 12.0' NGVD. Existing discharge facilities consist of 1 - 2.83'

wide sharp crested weir and 1 - 75' long, 2.5' diameter RCP discharging into Ten-Mile Canal via a roadside ditch. The site includes 38.83 acres of single family homes, 18.73 acres of water management, and 11.79 acres of commercial, and 5.14 acres of wet detention.

SFWMD Permit No. 36-00258-S is issued to C. Johnson (McGregor Baptist Church) for the construction and operation of a water management system serving 17.5 acres of institutional lands by a system of inlets and culverts, 2 detention ponds, 1 modified inlet, and 2 weirs discharging into Ten-Mile Canal. The property is located in S5/T45S/R25E. Discharge facilities include 1 - 2.5' wide weir at 16.3' NGVD with 2 0.5 bleeder orifices, 1-3.5' wide weir at 16.9' NGVD with 1 bleeder notch and 2 0.5 bleeder orifices at 16.4' NGVD. The total project area is 103.43 acres, including a church, associated infrastructure, and detention ponds. Permitted discharge is 17.5.

SFWMD Permit No. 36-00357-S is issued to Fort Myers Psychiatric Hospital for the operation of a water management system serving 10.0 acres of institutional lands via sheet flow over 2 acres in the northeastern corner of the project into a spreader swale and into an existing drainage ditch flowing north to south into the Canal. The remainder of the project drains via a system of swales and catch basins to 2 on-site lakes connected by an equalizer pipe. The control structure in the southern lake consists of 1 -38 square inch triangular orifice at 15.5' NGVD. The outfall consists of 245 LF of 30" diameter CMP culvert, discharging into the existing ditch. Permitted discharge is 2 cfs.

SFWMD Permit No. 36-00600-S is issued to Turtle Development Corporation for a modification to an existing permit. The total project area consists of 35.32 acres, of which 14.79 are permitted. The previous surface water management permit included the additional portions of the project. Discharge facilities are listed under previously permitted activities. The project is situated in S7/T44S/R25E.

SFWMD Permit No. 36-01176-S is issued to J. Woods and W. Pankow for the construction and operation of a surface water management system to serve 3.41 acres of industrial lands known as Metro 3.41 Industrial Buildings. The project is located in S7/T45S/R25E. The system consists of swales which convey runoff to a dry detention area. Discharge is via a control structure consisting of a 3.0" diameter bleeder orifice with invert set at elevation 12.5' NGVD and 12 LF of 12" x 18" ERCP culvert. Water quality monitoring is required. Permitted discharge is 0.68 cfs.

4.1.5.2 Agricultural Management Practices

The description of agricultural management practices in the Estero Bay Watershed and its Basins depends upon a general knowledge of the type of management practices, specifically those dealing with irrigation. The following discussion of general background information precedes the specific description of the practices in the Ten-Mile Canal Basin.

General Agricultural Management Practices

As discussed above, agriculture is the predominant land use within many of the secondary basins in the Estero Bay Watershed. As such, the management practices applied to agricultural lands can have adverse impacts on the quantity and quality of soils, surface water, and ground water in much of the study area. Likewise, through improved environmental performance of farming systems an excellent opportunity exists for large-scale improvement in water and soil quality and quantity.

The prevalent land uses within the eastern portion of the Estero Bay watershed are agricultural. Existing agricultural management practices in the study area were determined using three primary sources of information:

- 1) the 1995 land use,
- 2) the Lower West Coast Water Supply Plan (SFWMD, 1994), and
- 3) the SFWMD consumptive use and surface water permitting file information.

Information from these sources was reviewed and integrated to describe location-specific existing agricultural practices. Descriptions of irrigation types are presented below.

Flood and Seepage - Flood and seepage irrigation are low efficiency irrigation methods (about 50% efficiency). Flood or crown flood irrigation, often used for citrus groves, is an irrigation method that raises the water table by flooding the grove, then holding the water for a prescribed time period, followed by release into a nearby discharge canal. Seepage irrigation is often used for truck crops (vegetables) and involves water distribution and water table management via an adjacent ditch and a series of shallow lateral ditches.

Overhead and Volume - Overhead and volume gun irrigation systems have moderate efficiencies from 65% to 75%. Overhead and volume gun irrigation is used for citrus, improved pasture, truck crops, sod farms, and ornamentals. Both these systems are essentially above ground sprinkler systems. Overhead systems are usually fixed structures that spray a relatively broad area. Volume gun sprinklers are mobile units that are capable of directing their spray to a specific point, such as a citrus tree. Drip and Micro Jet irrigation systems (also referred to as trickle irrigation) utilize special applicators that distribute irrigation water directly to the root system.

Agricultural Management Practices by Crop Type

The following description of existing agricultural management practices used in the Estero Bay Watershed was summarized from the agricultural land use inventory and discharge study prepared by the USDA Soil Conservation Service (now the USDA Natural Resources Conservation Service (NRCS)).

Citrus

Cropping Sequence

Citrus trees typically decline at 20 to 25 years, and producers will often replace individual trees as fruit production decreases or as the trees appear in poor health. In some of the older groves, a program may be implemented which replaces from 10 to 20 percent of the old grove area each year. In other less frequent instances, an entire grove may be replanted at one time. Replanting can occur during any season, but young trees often require direct irrigation (e.g., trickle irrigation system), and can be harvested after three years of growth. Beds and row furrows are typically vegetated with Bahia grass or Bermuda grass, and in some cases groves are seeded with legumes (e.g., clover) which “fix” atmospheric nitrogen. The vegetation cover over the grove reduces soil erosion, decreases runoff, and increases infiltration of rainwater.

Grove Configuration

Citrus groves have trees planted on elevated, or bedded, tree rows between a series of 12 to 48 inch deep furrows. Older type groves typically consist of single beds about 25 feet wide. More recently, double beds are planted with two rows of trees per bed with furrows spaced from 50 to 60 feet apart. The elevated beds provide appropriate drainage for the tree roots systems. The double bedded citrus groves provide for easier operation and a higher tree density per acre. Furrow length is variable, but is commonly about 1,200 feet in length. Furrows are often sloped at 1:600 for best drainage and water table management, and are generally designed to remove 4 inches of water in 24 hours. Furrows are usually connected into an outlet ditch via a grade stabilization structure (pipe drops). Outlet ditches may consist of farm ditches, Water Control District ditches and canals, or canals. It should be recognized that the ditches adjacent to citrus groves often store water which may be pumped into the furrow system or allowed to gravity drain into furrows if crown flood irrigation is used.

Rooting Depth and Water Requirements

Rooting depth is dependent upon water table depth. A rooting depth from 12 to 24 inches is typical for citrus grown in flatwood soils, the dominant soils where citrus is grown. In less common deep sandy ridge soils, the rooting depth may be 48 inches or more. Providing good drainage in citrus groves is critical during the wet season. Citrus roots may become damaged if saturated for more than 48 hours. Excess water from farm ditches, therefore, is pumped or gravity drained into adjacent canals through one or more structures consisting of either a flashboard riser or slide gate type corrugated metal pipes (12-60 inches in diameter). Water table management for citrus groves is also controlled through management of canal water levels.

Institute of Food and Agricultural Science (IFAS) research has shown that from January through July, due to blooming and fruit setting, there should not be more than 30% depletion of available water

in the root zone. Water requirements are less critical from August through December, where 50 percent depletion of available water is adequate. The peak consumptive use of citrus trees is 0.2 inches per day.

The yearly water consumptive use total for citrus in the Indian River Lagoon Watershed is 40.25 inches. It is estimated that citrus receive, on the average, 25.14 inches per year of effective rainfall, thereby yielding a net irrigation requirement of 15.11 inches for a normal year. With citrus being a dominant crop in the study area, irrigation systems must be designed to meet the “peak consumptive use” of the crop, and due to varying rainfall distribution, irrigation water must be applied when rainfall is low. The following section summarizes citrus irrigation methods in the study area.

Irrigation

Crown flood irrigation applies water to soil and the water table by flooding bedded citrus groves. Water is supplied at rates from 8 to 25 gallons per minute per acre to the grove bed furrows to raise the water table to or near the top of the bed. After the irrigation cycle, water is released into a nearby discharge canal. Crown flooding is usually used once every four weeks during the winter, once every two weeks during the late winter to early summer, and once every two to four weeks from early summer to late winter depending on rainfall.

Water is obtained from either artesian wells within the grove, or by pumping or gravity flow from an adjacent canal or ditch. It is important to recognize that discharged crown flood water from a grove is often reused to irrigate other groves downstream.

Crown flood irrigation application time is generally up to 24 hours of intake, hold for up to 24 hours, followed by drainage for up to 24 hours. The entire cycle usually lasts from 24 to 48 hours. Some growers, however, can complete the cycle in considerably less time due to short intake times when pumping water into the grove. About 0.5 acre-feet of water per acre is released from groves per irrigation cycle (about 163,000 gallons per acre per irrigation event).

Crown flood irrigation is generally discouraged by NRCS due to low water use efficiency. Efficiencies can range from 20 percent to more than 60 percent in terms of the crops’ ability to use applied water. However, since much of the water used in crown flood systems can be reused for downstream groves, overall efficiency estimates can range from 40 to 80 percent. Most citrus operations are converting their groves from crown flood irrigation to more efficient trickle irrigation systems, and virtually all new groves are designed for trickle irrigation.

Trickle irrigation systems (drip and Micro Jet) efficiently apply water directly to the root zone by means of applicators. The most common system used for citrus is spray jet or micro sprinkler irrigation where typical flow rates range from 10 to 30 gallons per hour with a wetted diameter of

5 to 30 feet. Trickle systems are used about once per week in the winter for 4 to 8 hours for mature trees, and from 1 to 3 hours on young trees. The systems are generally used twice per week during the late winter to early summer, and twice weekly or every other day if the weather is dry and the water table is low.

Micro sprinklers (Micro Jet) and drip systems have higher water use efficiencies than flood irrigation systems. Micro sprinkler efficiencies range from 75 to 90 percent, with lower efficiencies attributed to poor system design causing uneven application over the grove. Some water is lost to evaporation and to applications outside the root zone. Drip systems may have higher water use efficiencies and have essentially no water loss. Crop use efficiency, however, may not be as great as micro sprinkler systems since water is not applied over the entire root zone and thus more frequent irrigation cycles may be needed. Although micro sprinkler and drip systems have different characteristics, their overall water use and efficiencies are about the same.

Other systems, although used less frequently, include solid set sprinklers and high volume guns. High evaporative losses, wind displacement problems, and high operation costs hamper both these systems.

Pest Management

Pesticides include a variety of chemicals (herbicides, insecticides, fungicides, nematicides, algicides, piscicides, wood preservatives, and fumigants) to control plant pests and enhance crop production. In some cases, such chemicals can cause harm when introduced to aquatic environments by eliminating or reducing populations of desirable organisms. Some organisms will accumulate pesticides in their bodies to concentrations above those in the surrounding environment. If these organisms are in turn eaten by higher animals, including humans, the pesticide and its associated toxicity may then be passed to that animal.

The amount of pesticide that may enter a waterbody from runoff depends on: the intensity and duration of rainfall or irrigation; the time between application and rainfall; the amount applied, the length, slope, and soil type of the land; the extent of exposure to bare soil, proximity to a water body, the application method, and the extent of use of BMPs. Pesticides are either in dissolved form or attached to sediment particles during transport as runoff. Dissolved forms can be leached to ground water supplies, while both dissolved and attached forms can be transported to nearby surface waters. Although surface runoff from agricultural lands is considered the major route of pesticide transport to the aquatic environment, other routes include: spray drift, atmospheric transport and deposition, intentional application, and domestic sewage and spills.

Without pesticide use, insects and diseases would reduce crop yields to unprofitable levels. All pesticides registered for Florida are labeled as to application rates, approved methods and timing of applications, target pests to be controlled, appropriate target crops, and any special limitations. The

Cooperative Extension Service provides training and guidance on the selection, use, and handling of registered pesticides to area growers as needed.

Citrus growers in the study area use Integrated Pest Management (IPM) techniques, herbicides, fungicides, insecticides, and nematicides. IPM involves pest scouting, pest identification, and population counts to determine economic threshold levels. Due to the economic advantage of using IPM, grove managers in the study area have been using these techniques for years. The IPM selection process allows growers to weigh all factors with regard to leaching or run-off potential of the soil, the leaching or run-off potential of various pesticides, and potential effects on human health and aquatic systems.

The most commonly used herbicides include Roundup, Krovar, Solicam, and Princep. These are used around trees two to three times each year to control weeds. They are applied in February or March, June, and finally in the fall of each year. The herbicide Rodeo is also used regularly to control weeds in irrigation and drainage ditches.

Fungicides are typically sprayed on fresh grapefruit three to five times per year. Greasy spot, scab, and melanose are controlled using a copper fungicide. Miticides (usually Ethion) are used to control mites, and are often added into the post-bloom, delayed post-bloom, and summer oil sprays. In order to minimize miticide usage, growers periodically scout groves for mites.

Insecticides and nematicides also must be used on groves in the study area. Temik serves to control nematodes and to increase tree vigor and yield, and its use precludes the need for the post-bloom miticide application. Dipel and Lorsban are used to control the caterpillar (called orange dog). Fire ants may be controlled with Logic, Lorsban, and Diazinon.

The NRCS is working with growers to reduce the risk of pesticide spills by providing chemical mixing center designs and funding assistance for their construction. In general, mixing areas should be located away from surface or ground water sources. Furthermore, the use of close-transfer systems and new soluble packaging for chemicals are methods used to minimize the accidental and/or incidental releases of pesticides into the environment.

Nutrient Management

Due to the multitude of production variables, research has not produced optimum rates of nitrogen application for citrus. Some general guidelines, however, have been reported. Mature trees may require from 100 to 300 pounds of nitrogen per acre per year. This rate will vary depending upon soil type, yield, tree health, and tree density. Yield response does not appear to increase much after rates from 150 to 200 pounds are applied (irrigated trees), and additional applications may reduce fruit yield and quality.

Phosphorus is typically applied in quantities to replace the amounts removed by each crop. These rates only amount to about 20 pounds of P205 per acre. An application rate of 400 pounds of 20 percent superphosphate per acre every 4 years is adequate in most circumstances. Many growers will have their soils tested to determine the exact soil needs, but some routinely apply 40 to 60 pounds of P205 annually to meet their needs.

Grazing or Pasture Land

Most livestock operations within the Estero Bay Watershed study area are low density cow-calf operations. The goal of these operations is to produce a healthy brood herd for the production and sale of offspring. Animal densities for introduced forage species on pasture land are commonly from 3 to 5 acres per animal unit. Animal densities on rangeland vary between 7 and 20 acres per animal unit depending upon range conditions and vegetation available. An animal unit is defined as one 1,000 pound cow and a 6 month old calf.

Land Management

Rangelands contain native plant communities and are managed from an ecological perspective by employing planned grazing/browsing and prescribed fire as maintenance tools. Roller chopping/grazing deferment is often used to return deteriorated plant communities closer to their natural composition. After chopping, a 90-day grazing deferment during the growing season provides native vegetation the opportunity to revegetate. Roller chopping is often used on rangelands and is accomplished by pulling a steel drum with horizontal blades over rangeland. The device serves to even-out the height and density of herbaceous plants and brush species, thus shifting the competitive edge to favor the reestablishment of native herbaceous plants.

Pasture land is often fertilized to enhance livestock production. About 50 percent of pasture acreage has been planted with Bahia grass which needs very little fertilization. Established Bahia grass needs only at most about 60 pounds of nitrogen per acre annually. A soil test is recommended on all pasture land prior to fertilization.

Pasture land used to grow hay is typically fertilized in the spring and August with 40 to 80 pounds of nitrogen per acre annually. Much smaller amounts of phosphorus are required each year, and the amounts are usually based on soil tests. Rye and rye grass are planted for winter forage. Cool season fertilization rates are usually based on soil test results and typically only require about 30 pounds per acre of nitrogen applied during October or November.

Pesticides are applied to pasture land as needed by each rancher. Generally, land users avoid the use of chemicals and seek alternative methods to control weeds and insects. For example, some land users will mow for mole crickets at a cost of \$5 to \$8 per acre as opposed to using mole cricket bait at a cost of \$18 per acre.

Vegetable Crops (Truck Crops)

Irrigation

Most vegetables are irrigated by sub-irrigation seepage systems. Water is pumped to the field via an open ditch, and then distributed through the field by a network of shallow lateral ditches. Water table management is extremely important, and the table height is held at a constant level for most of the growing season. These systems are considered inefficient, with crop water use efficiency from 20% to 60%. The use of underground conduit delivery systems in place of open ditches can increase crop water use efficiency to as high as 85%. Water use efficiency can also be improved by system maintenance, irrigation scheduling, and the use of water table monitoring wells and measuring devices. Evaporative losses can be minimized by using plastic cover.

Pesticides

Potatoes are particularly susceptible to nematode injury from cutworm, tuberworm and wireworm, along with the larvae of the cucumber beetle. In order to protect these crops, nematicides are typically applied to potato crops.

Ornamental Plant Nurseries

Three categories of nurseries can be distinguished: container grown (grown in pots), field grown (grown in the ground), and glass enclosed (grown in greenhouses). Potential water quality impacts for field and glass enclosed grown plants is similar since greenhouses have no floors. Container grown plants are susceptible to drying, require regular watering, and thus can be a source of pesticides and fertilizers to water resources.

Most nurseries use overhead sprinklers. Field grown operations rely on water table level management for irrigation, and require sprinkling once per week during drought conditions. Container grown operations must water two days each week, thus increasing the chance of leaching of nutrients and pesticides into the environment. Nurseries discharge irrigation water by gravity, and these operations lack stormwater retention or detention ponds.

Pesticide use in nurseries is reportedly very limited. Nursery operators must be licensed to use restricted pesticides and pesticide costs are high. Most operations routinely spray fungicides during the summer months at frequencies ranging from once every two weeks to once every three months. Insecticides used include Diazinon and chlorpyrifos-Dursban (for mites, aphids mealybugs); Orthene (for whiteflies, backflies, aphids); and Seven, Cygon, Ethion Oil, and Malathion (also for whiteflies, backflies, aphids, but to a lesser extent).

Ten-Mile Canal Basin includes 8,717 acres, and is located west of the Six-Mile Canal Secondary Basin and east of the Hendry Creek Secondary Basin. Approximately 19% (1,694 acres) of the Ten-Mile Canal Basin includes agricultural land uses (Table 4-2). Information was obtained from the SFWMD permit files.

Agricultural uses are predominantly cropland and pasturelands and tree crops (citrus). Agricultural land use estimates for all major irrigated crops for 1990 in the basin are listed in Table 4-4. Permitted groundwater withdrawals in the basin are listed in Table 4-5 and summarized in the following paragraphs.

Table 4-4. 1990 estimated irrigated crop acreages in the Ten-Mile Canal Basin.	
CROP	ACREAGE
Improved Pasture	27
Row Crops	293

Table 4-5. Permitted discharges (cfs) and groundwater withdrawals (MG) for the Ten-Mile Canal Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED ANNUAL DISCHARGE/WITHDRAWAL
Groundwater withdrawal			
36-00153-S/W	466	Shallow Aquifer	361 MG
Surface water discharge			
36-02411-S	44.83	-	3 cfs
36-00736-S	188.1	-	40 cfs

SFWMD Permit No. 36-00153-S/W is issued to A. Nychyk (Nychyk Brothers Farm) for the use of groundwater and surface water from the Shallow Aquifer and rockpit for agricultural irrigation serving 466 acres with a monthly withdrawal of 361 MG. The project is located in Lee County, Sections 3-5, 10/T46S/R25E. Withdrawal facilities are 11 - 6" and 1 - 8" well pumped by 5 pumps, with a total capacity of 6498 gpm. The permit also includes operation of a water management system serving 1772 acres of agricultural lands by dikes, ditches, and 2 - 16,666 gpm, 1 - 25,000 gpm, and 1 - 11,000 gpm pumps discharging via sheet flow into Alico grade road ditch and eventually into Ten-Mile Canal. Water quality monitoring is required. Permitted discharge is 104 cfs. The 1772 drained acres include 466 acres of squash.

SFWMD Permit No. 36-02411-S is issued to J. States (Commercial Corners/ Six-Mile OMNI Trust) for the construction and operation of a water management system serving 44.83 acres of agricultural

lands discharging via existing ditch to Ten-Mile Canal. The property is located at S33/T44S/R25E. Discharge facilities include 1 - 4' wide horizontal circular weir with crest at elevation 19.88' NGVD; 1 - 0.58' diameter circular orifice with invert at elevation 19.1' NGVD; and 32 LF of 2.5' wide x 1.58 high elliptical culvert, discharging into an onsite swale. Water quality monitoring is required. Of the total 44.83 acres, 38.6 is farmed and flows to a 3300 gpm pump which then discharges into a 4.6 acre wet detention area via a single control structure. Permitted discharge is 3 cfs.

SFWMD Permit No. 36-00736-S is issued to Harper Brothers Inc. (Farm) for the construction and operation of a water management system serving 580 acres of agricultural lands discharging into Ten-Mile Canal. The property is located in S4,5/T45S/R25E. The project area includes 188.1 acres of farm lands, 32.2. acres of water management in the form of a rock mining pit, 7.3 acres of mitigation area, and 352.4 acres remaining in improved pasture lands. Runoff from the farmed area is routed to the 32.2 acre detention area/mining pit via 1 - 5,000 gpm, 1 - 10,000 gpm, and 1- 20,000 gpm pump, and a system of interior swales and ditches. Discharge from the detention area will be through 1 - 45 degree v-notch bleeder with invert at 16.0' NGVD and 60 LF of 30" diameter CMP culvert into an existing swale which flows to a 31.4 acre on-site wetland, then into a 70.3 acre wetland via 1 - 140 degree v-notch bleeder with invert at 15.0' NGVD and 40 LF of 42" diameter CMP culvert. Discharge from the wetland is via a 25' wide weir with crest elevation 14.5' NGVD into an off-site lake. Discharge from the lake is via 1 -24.0' wide weir with crest elevation at 14.0' NGVD into an off-site wetland via 1 - 29.0' wide weir with crest elevation at 13.0' NGVD into an existing railroad right-of-way, which then discharges to Ten-Mile Canal. Permitted discharge is 40 cfs from the property and 136 cfs for the entire drainage basin.

4.2 Six-Mile Cypress Slough

The Six-Mile Cypress Slough Basin includes over 35,000 acres of the Estero Bay Watershed located entirely in Lee County. Six-Mile Cypress Slough flows along the west boundary of the basin. The basin extends north from Alico Road (the northern boundary of the Mullock Creek Basin) to the Colonial Blvd. Expressway. Six-Mile Cypress Expressway is the western boundary of the basin and it extends east to Immokalee Road. I-75 bisects the Six-Mile Cypress Slough Basin from north to south and another major feature is the Southwest Florida International Airport in the southeast quarter of the basin. The topography, soils, hydrology, land use, drainage features and land use of the Six-Mile Cypress Slough Basin are described in the following sections.

4.2.1 Topography

The Six-Mile Cypress Slough Basin rises in elevation to the 20 foot contour along its eastern portion and does not drop below 10 feet NGVD except along the slough and S.R. 41 at its southernmost extent. Elevations in the basin range from about 10 feet NGVD west of I-75 to more than 20 feet

along Immokalee Road at the east boundary. Agriculture and upland forest occur at the higher elevations, while wetlands occur throughout the lower elevations associated with Six-Mile Cypress Slough and other smaller sloughs.

4.2.2 Soils

Soils in the Six-Mile Cypress Slough Basin are more variable than those described for the lower-lying basins. Soils of flatwoods and sloughs dominate the basin. These soils are primarily of the Oldsmar-Malabar-Immokalee and Immokalee-Myakka type and are nearly level, poorly-drained, deep sandy soils. Similar, but shallower soils bordering the swamps and slough soils are Hallandale-Boca soil types. Isles-Boca-Pompano soils located along sloughs and wetlands in the basin. The water table in these depressional soils is above the surface for 3-6 months of the year. These soils are generally composed of the coastal Holocene sediments and undifferentiated shell beds in the interior portion of the Estero Bay Watershed. Anthropogenically altered or arent soils, e.g., dredge and fill, shell mounds, and landfills also occur in the basin.

The majority of the individual soils series within the 34,383 acres of mapped soils in the basin have been defined as HSG D (Plate 4-3). These soils total approximately 33,033 acres (Table 4-6). HSG-designated D soils have very slow infiltration rates when thoroughly wetted, thus, the runoff within the basin is expected to be high. These soils are primarily clay with a high permanent water table or shallow soils over nearly impervious materials, such as a clay pan or clay layer.

The remaining soils are designated as groups A, B, and C and have low to high runoff potential. These are the more interior soils with slow infiltration rates when thoroughly wetted, often with a layer of soil that impedes the downward movement of water. These soils make up only 4% of the soil types in the basin. A, B, and C designated soils are associated with residential golf courses and parts of the airport.

Table 4-6. Hydrologic soil groups in the Six-Mile Cypress Slough Basin.		
HYDROLOGIC SOIL GROUPS	AREA (acres)	PERCENT COVER
A	0	<1%
B	0	<1%
C	1,350	4%
D	33,033	96%
TOTAL	34,383	100%

4.2.3 Existing Land Use

Existing land use acreages for the Six-Mile Cypress Slough Basin are presented in Table 4-7. A map of existing land use for the basin is presented in Plate 4-4.

Developed land use includes 16,407 (47%) acres of the Estero Bay Watershed, slightly less of the overall land use when compared with 18,056 acres (51%) of undeveloped/natural land cover. In contrast with the other coastal basins, the dominant developed land use is 6,494 (19%) acres of crop and pasture land distributed throughout the basin.

Less than 10% of the overall basin includes residential land use (3,080 acres), most of which is associated with Gateway Golf and Country Club and other smaller communities along Six-Mile Cypress Slough. A few small commercial areas are concentrated along Daniels Parkway.

Transportation and utilities make up 2,867 acres (8%) of the Six-Mile Cypress Slough Basin, nearly the same amount as residential. In addition to the Southwest Florida International Airport, a utilities easement and the I-75 corridor account for most of this area.

Nearly one-third of the basin is undeveloped and these areas are associated pine uplands as well as many cypress wetlands in the basin. In contrast with other coastal basins in which wetlands predominated, upland forested areas make up 10,217 acres (29%), the dominant undeveloped land cover in the Six-Mile Cypress Slough Basin, while wetlands account for 7,151 acres (20%) of the land use. Wetlands are predominantly cypress swamps, compared with wetland hardwood forests of the lower coastal basins, and Six-Mile Cypress Slough includes the largest cypress stand in Lee County (Pratt, 1980).

Open water occurs primarily as reservoirs and makes up only 564 acres (2%) of the basin. Water is primarily associated with drainage impoundments along I-75 and adjacent to the airport. These areas result in the discrepancy in total acres between soils and land use as a result of the area being designated as water in the soils map and disturbed land on the land use map.

Table 4-7 Land use and land cover for the Six-Mile Cypress Slough Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Residential		
Residential Low Density	1,770	5%
Residential Medium Density	913	3%
Residential High Density	391	1%
Residential - Mobile Homes	6	0%

Table 4-7 Land use and land cover for the Six-Mile Cypress Slough Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Subtotal	3,080	9%
Commercial/Industrial		
Commercial and Services	96	<1%
Industrial	374	1%
Institutional	31	<1%
Subtotal	501	1%
Barren Land		
Extractive	9	<1%
Disturbed Lands	1,208	3%
Subtotal	1,217	3%
Recreation and Open Land		
Recreational	896	2%
Open Land	1,303	4%
Subtotal	2,199	6%
Transportation and Utilities		
Transportation	2,504	6%
Utilities	813	2%
Subtotal	2,867	8%
Agriculture		
Cropland and Pastureland	6,494	19%
Tree Crops	39	<1%
Nurseries and Vineyards	10	<1%
Subtotal	6,543	19%
TOTAL DEVELOPED LANDS	16,407	47%
Shrubland and Brushlands	61	1%
Upland Forested		
Upland Coniferous Forests	9,549	27%
Upland Hardwood Forests	668	2%
Subtotal	10,217	29
Wetlands		
Wetland Coniferous Forests	4,612	13%
Wetland Hardwood Forests	953	3%
Vegetated Non-Forested Wetlands	1,129	3%

Table 4-7 Land use and land cover for the Six-Mile Cypress Slough Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Wetland Forested Mixed	457	1%
Subtotal	7,151	20%
TOTAL UNDEVELOPED LANDS	18,056	51%
Water		
Reservoirs	564	2%
Subtotal	564	2%
TOTAL	35,027	100%

4.2.4 Geologic and Drainage Features

The Six-Mile Cypress Slough Basin is characterized by surface and subsurface drainage features that interact with each other. There is a network of canals in the basin which provide stormwater and groundwater drainage for agriculture and residential areas, although approximately 20% of the basin is composed of undeveloped wetlands. The existing geologic and drainage systems are discussed in the following sections.

4.2.1.4 Hydrogeology

There are three major aquifer systems underlying the Estero Bay Watershed, including the Six-Mile Cypress Basin. These are the:

- ! Surficial Aquifer system,
- ! Intermediate Aquifer System, and
- ! Floridan Aquifer System.

The Surficial Aquifer is the uppermost aquifer and includes the water table aquifer, confining beds, and the lower Tamiami aquifer; the water table aquifer and the lower Tamiami aquifer are the two main water bearing formations. The water table aquifer is an unconfined aquifer of primarily undifferentiated sands, shell beds, calcareous clays, and some limestone. The semi-confining Tamiami confining zone separates the water table aquifer from the Lower Tamiami Aquifer.

The Surficial Aquifer is the most significant aquifer system since it is the closest to the surface and is at times in direct connection with surface water. The potentiometric surface of this aquifer follows land surface contours and for undrained areas, wet season water levels are seldom less than 3 feet above or below land surface. The water level in the water table aquifer and Lower Tamiami Aquifer in the Six-Mile Cypress Slough Basin ranges from 8 feet NGVD to approximately 20 feet NGVD from west to east across the basin (SFWMD, 1990).

Thickness of the Surficial Aquifer varies between 25 and 50 feet in central Lee County to and thickens toward the southeastern part of Lee County. Movement in the Surficial Aquifer is generally southwest and provides water for baseflow for major streams and rivers in the watershed.

In areas where the underlying Hawthorn confining zone is thin or absent the Surficial Aquifer is in direct hydraulic connection with the Sandstone aquifer. The upper Hawthorn confining zone separates the Surficial Aquifer from the Sandstone Aquifer in most of Lee County and ranges from 0 to 25 feet below the surface in the central portion of the watershed and the thickness decreases farther south and is absent near Bonita Springs.

The Intermediate Aquifer, also called the Hawthorn Aquifer, lies below the Surficial Aquifer and is comprised of the five major units listed below. The two water producing zones of this system are the Sandstone and Mid-Hawthorn aquifers (SFWMD, 1982).

- ! Upper Hawthorn Confining Zone,
- ! Sandstone Aquifer,
- ! Mid-Hawthorn Confining Zone,
- ! Mid-Hawthorn Aquifer, and
- ! Lower Hawthorn/Tampa Confining Zone.

The Floridan Aquifer underlies all of Florida. The top of the Floridan Aquifer is associated with the lower Hawthorn Formation and the Tampa Formation, the top of which ranges from -350 feet in northwestern Lee County to -700 feet in the southern portion of the county. The potentiometric surface of the Mid-Hawthorne Aquifer ranges from 10 feet NGVD along the coastal portion of the Mullock Creek Basin to nearly 40 feet NGVD along the eastern boundary.

The Sandstone Aquifer underlies the upper Hawthorn confining zone throughout nearly the entire watershed. The top of this unit occurs between 5 and 20 feet NGVD from the coastal areas to the northeastern boundary in the Six-Mile Cypress Slough Basin (SFWMD, 1990). In the northern part of the Estero Bay Watershed, the aquifer surface lies between 25 and 50 feet NGVD, but it dips in a southerly direction to 150 feet below the surface in the southeastern portion of Lee County.

The Tamiami and Hawthorn formations are approximately 40-580 feet in thickness in Lee County. These formations occur as limestones and dolomites and serve as reservoirs for the Tamiami and upper Hawthorn aquifers which supply freshwater. The Lower Hawthorn Aquifer water supply is highly saline (SWRPC, 1995).

4.2.1.2 Surface Drainage

Surface drainage is dependent on groundwater levels, rainfall, and the drainage network characteristics. Groundwater inflows and rainfall are inputs to the surface water hydrologic system,

whereas the drainage network controls the output. Groundwater levels were discussed in the preceding section.

Surface water generally moves west across the Six-Mile Cypress Slough Basin as sheetflow into Six-Mile Cypress Slough, which then drains southwest into Ten-Mile Canal before entering north Estero Bay. From the airport, water flows north and then west, and water moves west via flowways beneath I-75 bridges and culverts. Sheetflow of water in the southern portion of the basin is west, directly into Ten-Mile Canal.

4.2.5 Management Practices

Approximately 47% of the Six-Mile Cypress Slough Basin is classified as urban and agricultural lands (Table 4-7). The urbanized areas of the basin are dispersed throughout the basin. The discussion of urban management practices is divided into urban water uses and urban water discharges. The water uses and water discharges are listed in the following descriptions.

4.2.5.1 Urban Management Practices

Of 16,407 acres of urban and agricultural acres (47%) in the Six-Mile Cypress Slough Basin, 3,080 acres (9%) are residential. Recreation and open lands and commercial and industrial land uses each make up 8 -10% of the land use in the basin. Table 4-8 lists the surface water discharges permitted in the basin and any permitted withdrawals. Descriptions of permitted discharges and groundwater withdrawals are summarized below. Permitted activities are primarily for residential and commercial uses in the basin.

Table 4-8. Surface water discharges (cfs) permitted in the Six-Mile Cypress Slough Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED ANNUAL DISCHARGE/WITHDRAWAL
Surface water discharge			
36-01077-S	313.3	-	21 cfs
36-00678-S	37.77	-	0.06 cfs
36-00334-S	274	-	18 cfs
36-01473-S	249.7	-	14 cfs
36-01267-S	125.4	-	8 cfs
36-01872-S	249.4	-	14.4 cfs
36-01747-S	52.93	-	1.8 cfs

Table 4-8. Surface water discharges (cfs) permitted in the Six-Mile Cypress Slough Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED ANNUAL DISCHARGE/WITHDRAWAL
36-01662-S	80.33	-	2.19 cfs
Groundwater withdrawal			
36-01473-W	25	Sandstone Aquifer	28.5 MG

Water use and surface water management permits within the basin have been issued as follows:

SFWMD Permit No. 36-00377-S is issued to E.L. Johnson, developer for Danport Center, for the construction and operation of a surface water management system serving 9.76 acres of commercial lands by curbs, gutters, catch basins, dry detention areas, 3 weirs, and 4 culverts discharging into Six-Mile Cypress. The total project area includes 416 acres of mixed use: 148.1 acres are for water management (30.2 acres of existing cypress wetlands, 15.4 acres of proposed mitigation of wetlands, and 15.2 acres of flowway), and 175.5 acres are impervious surface. Discharge facilities are:

- 1 - 0.75' wide weir with crest at elevation 18.5' NGVD;
- 1 - 2.0' wide weir with a crest at elevation 18.5 NGVD;
- 1 - 2.0' wide weir with a crest at elevation 20 NGVD;
- 1 - 40° V-notch bleeder with an invert at 18.5 NGVD;
- 1 - 7.75" wide by 1.6' high inverted triangular orifice with an invert at elevation 18.5 NGVD and 90 LF of 30" diameter RCP culvert;
- 85 LF of twin 24" x 38" RECP culvert; and
- 56 LF of twin 24" x 38" RECP culvert.

SFWMD Permit No. 36-00734-S is issued to F.A.R. Development, Inc (Briarcrest Subdivision) for the purpose of constructing and operating a water management system serving 48.96 acres of residential lands and discharging into Six-Mile Cypress Slough. Permitted discharge is through 1 - 3.1' wide weir with crest at elevation 11.0' NGVD and 125 LF of 18" diameter RCP culvert. The project site includes 80.5 acres, 31.54 of which have been deeded to the County. An 80 unit single family home development is planned. A system of swales and culverts will convey water to an on-site 4.63 acre detention pond. Discharge will be to Six-Mile Cypress Slough through 1 - 8" diameter circular orifice with an invert at 11.5' NGVD and 310 LF of 19" x 30" ERCP culvert.

SFWMD Permit No. 36-01077-S is issued to Old Hickory Club, Inc for the construction and operation of a water management system serving 313.3 acres of residential lands discharging via existing flow ways and culverts into Six-Mile Cypress Slough. The project area is located in Lee County, S27/T45S/R25E. Two weirs and 2 culverts direct flows to on-site wetlands and then to Six-Mile Cypress Slough. Eleven acres of wetlands were impacted by the project and mitigation through

constructed wetlands and enhancements are required. Fifty-three acres on the project site are cypress wetlands. Discharge facilities are a 0.5' high x 6.0' wide bleeder with 264 LF of culvert and 200 LF of spreader swale, a 3" diameter circular orifice with an invert at elevation 19.0' NGVD, with 16 LF of culvert and 50 LF of spreader swale, and a 28 acre wet detention pond. Permitted discharge is 21 cfs.

SFWMD Permit No. 36-00434-S is issued to U.S. Home Corporation (Cross Creek) for the construction and operation of a water management system serving 266.3 acres of residential lands by lakes, 1 - 50' wide floodway easement, 1 - 30' and 1 - 40' wide interceptor swales, 1 - modified inlet, 1 - 12", 2 - 18" and 2 - 24" wide weirs and 1 - 40 LF x 42", 1 - 70 LF x 36", 1 - 90 LF x 42", 1 - 150 LF x 42", and 1 - 160 LF x 42" diameter RCP culverts discharging via a spreader swale and on-site cypress preserve into the Daniels Road swale and into Six-Mile Cypress Slough. The project is located in Lee County, Sections 17,20/T45S/R25E. Storm sewer systems direct runoff to on-site wetlands prior to discharge via spreader swales. Land use is presently residential.

SFWMD Permit No. 36-00388-S is issued to Alamo Rent-A-Car for the purpose of the construction and development of a water management system serving 5.13 acres of commercial/industrial lands in Lee County, S23/T45/R25E. The project includes 3.29 acres of porous gravel for drainage. Discharge is to Treeline Ave. Roadside swale via 18 LF of 17" x 13" CMPA culvert. Existing facilities also include a 0.17 acre on-site pond. Water flow is conveyed to Six-Mile Cypress Slough via overland sheetflow.

SFWMD Permit No. 36-00379-S is issued to Herbert Martin (Source, Inc) for the purpose of construction and operation of a water management system serving 62.1 acres of industrial lands by a storm sewer system, swales, dry detention areas, on-site lakes, 1 - 1'5" wide triangular orifice with invert at 18' NGVD, 1 - 80 LF x 18" diameter CMP culvert, 1 - 600' swale, 1 - 30 LF x 24" diameter CMP culvert discharging via an existing I-75 swale which flows north 450' to existing twin 4' x 6' box culverts to Six-Mile Cypress Slough. The project area includes a total of 62.1 acres, 9.78 of which are in water management, 33.76 acres are impervious, and 18.6 acres are in commercial/industrial use.

SFWMD Permit No. 36-00318-S is issued to William Maddox (Eagle Ridge Golf and Tennis Club, Ltd) for the construction and operation of a water management system serving 401 acres of residential and recreational lands by swales, inlets, culverts, system of lakes, 1 - 80 LF x 19" x 30", 11 - 75 LF x 19" x 30", and 21 - 70 LF x 19" x 30" RECP culverts, 1 - 90' and 1 - 220' wide drainageways merging into 1 - 250' wide floodway, 1 - 1.1', 1 - 3.3', 1 - 4.4', and 1 - 4.0' long and 1 - 250 LF x 24", 1 - 190 x 21", 1 - 21 LF x 30" and 2 - 40 LF x 30" CMP culverts discharging into Six-Mile Cypress Slough. The project is located in Lee County, S29/T45S/R25E.

SFWMD Permit No. 36-00080-S/W is issued to the Lee County Port Authority (Southwest Florida Regional Airport) for the continuation of an existing use of groundwater from the mid-Hawthorn aquifer for landscape irrigation serving 19 acres of grass with an annual allocation of 22.2 MG.

Withdrawal facilities are 4 existing 6" x 270' wells cased to approximately 200 feet. The land use in the project area is industrial. The permit also includes the construction and operation of a water management system serving 3,515 acres of commercial lands by storage areas, swale system and water control structures discharging into Six-Mile Cypress Slough via a 1,300 acre environmental buffer area.

SFWMD Permit No. 36-00251-S is issued to Florida Power and Light Company for the construction of 7.0 miles of single-lane unpaved access/patrol road, structure pads, cross drains consisting of 84 various sized culverts, and 2-240KV aerial transmission lines. The project area is located in Lee County, Sections 7, 8, 16, 17, 21, 28, 29, 31, and 32, T45S/R26E. The road will provide access around the Fort Myers Regional Airport. Culverts serve as cross drains only and do not discharge.

SFWMD Permit No. 36-00251-S is issued to Lee County Board of County Commissioners for the purpose of constructing 2.3 miles of divided four-lane road as the Colonial Boulevard Extension. The project site is in Sections 25-27, 34, 35/T44S/R25E. The project includes a bike path, two culvert crossings of Six-Mile Cypress Slough and swales on each side of the roadway within the strand. Permitted culverts consist of twin 12' x 6' box culverts with upstream invert elevations of 16' NGVD upstream and 15.7' NGVD downstream. A 1.5 mile collector swale is along the north side of the roadway across Six-Mile Cypress Slough with 1.5 mile spreader swales on each side.

SFWMD Permit No. 36-00678-S is issued to Gateway Services Dist. (Gateway Community) for the construction and operation of a water management system serving 476.4 acres of residential/commercial lands discharging into Ten-Mile Canal via Six-Mile Cypress Slough. A modification to the permit includes the construction of a conveyance swale and temporary control structure for a system discharging into Six-Mile Cypress Slough and then Ten-Mile Canal. The proposed alignment traverses 2.92 acres of transitional wetlands, 1.7 acres cypress wetlands and 1.85 acres wet prairie. The applicant proposes to preserve 4.46 acres of cypress wetlands, create 6.3 acres cypress swamp and 2.78 acres of marsh. Portions of the conveyance will follow the current alignment of an existing culvert beneath I-75 and will ultimately discharge to the borrow pit adjacent to the Gateway marsh wetlands project. The project site is located in Lee County, Sections 18, 19, 7/T45S/R26E. Discharge facilities:

- 1 - 10" wide weir with crest elevation 24.0' NGVD, with
- 2 - 60" x 48" sluice gates with inverts at elevation 18' NGVD;
- 1 - 15.0' wide weir with crest elevation at 22.0' NGVD, with
- 2 - 60" x 48" sluice gates with inverts at elevation 16.0' NGVD;
- 2 - 25.0' wide weir with crest elevation at 21.0' NGVD;
- 2 - 25.0' wide weir with crest elevation at 17.0' NGVD; and
- 1 - 5' wide weir with crest elevation 18.0' NGVD.

SFWMD Permit No. 36-00678-S is issued to WCI Communities Limited Partnership for the modification of a surface water management system serving 37.77 acres of residential development

known as Callaway Greens-Parcel 40A/B - Gateway. The project area is located in Lee County, Section 1, 12/T45S/R26E. Existing facilities include the previously constructed and presently operational Gateway main conveyance system for surface water. The facilities consist of surface water management areas to serve a 75 lot single family residential development and include 3.73 acres of lakes, as well as 2.21 additional proposed acres of lakes. Permitted discharge is 0.06 cfs.

SFWMD Permit No. 36-00605-S is issued to Ronald C. Francisco, Trustee (Airport Commerce Center) for the construction and operation of water management system serving 29.4 acres of industrial lands discharging into Six-Mile Cypress Slough via an existing cypress head. The permit was modified to include the construction and operation of a water management system serving 1.67 acres discharging into Six-Mile Cypress Slough via a cypress head. Conceptual approval has been issued for an additional 46.4 acres and there is a request for modification to add east and west roadway and cul-de-sacs, divide the property into 22 lots, and construct and operate another lot.

SFWMD Permit No. 36-00571-S is issued to the Colony of Fort Myers (a Florida General Partnership) for the construction and operation of a water management system serving 34.37 acres of residential and commercial lands discharging via on-site lakes and roadside swales into Six-Mile Cypress Slough. A modification to the permit includes the construction and operation of a surface water management system serving 3 additional parcels and a 70.27 acre residential project discharging to Six-Mile Cypress Slough via roadside swales. Proposed land use is single family home sites with related roadway, drainage, and utility improvements. An additional 87.1 acres were previously permitted. The total project area includes 143.2 acres located in Lee County, S20/T45/R25. Existing discharge facilities consist of:

Control structure 1: 1 - 0.9' high by 0.5' wide bleeder with invert at 16.0 NGVD and 100 LF of 14" x 23" culvert discharging to Eagle Creek Ditch, and
Control structure 2: 1 - 1.0' high x 1.06' wide bleeder with invert at 16.0' NGVD and 100 LF of 14" x 23" culvert discharging to Eagle Creek Ditch.

SFWMD Permit No. 36-00571-S is issued to Lee County Board of County Commissioners Division of Transportation for the construction of a water management system serving 8.2 miles of 2-lane roadway by swales, 2 - 72" RCP culverts and 3 - equalizer culverts discharging via Six-Mile Cypress Slough into the Ten-Mile Canal. The project area is located in Lee County, T44S and 45S/R24E and 25E. This permit is for the construction of 8.2 miles of Six-Mile Parkway in Lee County. Existing 2 - 72" RCP culverts cross the roadway and 8' x 8' concrete box culvert north of Daniels Rd. Intersection are intended to maintain flowways. The road functions as drainage divide between Six-Mile Cypress Slough and Ten-Mile Canal.

SFWMD Permit No. 36-00334-S is issued to Waste Management, Inc. of Florida (Gulf Coast Landfill) for the construction and operation of a water management system serving 274 acres of sanitary landfill discharging via sheetflow onto adjacent property into Six-Mile Cypress Slough. An

approved modification permitted an increase in the total project to 318.56 acres and a modification of the control structure. The project area is located in Lee County, S36/T44S/R25E and includes 158.55 acres of landfill and facilities, 92 acres of water management area, 13.82 acres of perimeter ditch, 29.39 acres of natural and cypress area, approximately 23 acres of access road and maintenance areas. Water quality monitoring is required. Permitted discharge is 18 cfs. Discharge facilities consist of: 1 - 104 degree v-notch weir with an invert at elevation 22.75 NGVD attached to 30 LF of 1' x 5' concrete box culvert. The control elevation is 22.75' NGVD.

SFWMD Permit No. 36-00334-S is issued to Waste Management, Inc. of Florida (Gulf Coast Landfill) for the construction and operation of a water management system serving 274 acres of sanitary landfill discharging via sheetflow onto adjacent property into Six-Mile Cypress. An approved modification permitted an increase in the total project to 318.56 acres and a modification of the control structure. The project area is located in Lee County, S36/T44S/R25E and includes 158.55 acres of landfill and facilities, 92 acres of water management area, 13.82 acres of perimeter ditch, 29.39 acres of natural and cypress area, approximately 23 acres of access road and maintenance areas. Water quality monitoring is required. Permitted discharge is 18 cfs. Discharge facilities consist of: 1 - 104 degree v-notch weir with an invert at elevation 22.75 NGVD attached to 30 LF of 1' x 5' concrete box culvert. The control elevation is 22.75' NGVD.

SFWMD Permit No. 36-00287-S is issued to Fiddlesticks Country Club for the construction of a 1.5 mile length of roadway between Fiddlesticks Country Club and Daniels Road in Lee County. The roadway will cross a very flat, poorly draining area in the Six-Mile Cypress Watershed. The minimum road crown elevation is 21.5' NGVD and pre-development flows will be maintained by twelve culvert crossings along the roadway and grassed swales on both sides. The culverts include:

- 3 - 43" x 68" RCPA's
- 7 - 24" diameter RCP's
- 2 - 30" diameter RCP's

SFWMD Permit No. 36-01473-S is issued to Cross Creek Associates for the construction and operation of a water management system serving 249.7 acres of residential land. A system of inlets, culverts, and swales direct runoff to 28.8 acres of detention area. Runoff from the detention area is directed through a control structure consisting of 1 - 1.6' wide weir with a crest at elevation 17.3' NGVD, 1 - 90 degree V-notch bleeder with an invert at elevation 16.5 NGVD and 100 LF of 30" diameter RCP culvert discharging to Estero Bay via Six-Mile Cypress Slough and 10 Mile Canal. Allowable discharge is 14 cfs.

SFWMD Permit No. 36-01473-W, issued to Cross Creek Estates Associates, authorizes the use of groundwater and surface water from the sandstone aquifer and an on-site lake system for landscape irrigation serving 25 acres. The property is located in S16/T45S/R25E, in Lee County. Annual

maximum permitted withdrawal is 28.5 MG. Withdrawal facilities are: 2 - 6" x 140 gpm wells cased to 70'; and 7 - 3" x 140 gpm x 10 HP surface water pumps.

SFWMD Permit No. 36-01267-S is issued to David C. Brown (Airside Plaza) for property located approximately 2 miles east of I-75 on the north side of Daniels Road in Lee County. The total project and drainage area is 125.4 acres, and has been designed as a mixed-use development. A system of swales and culverts will route storm water runoff into 8.3 acres of lake. Discharge is through 1 - 0.3' wide rectangular bleeder notch with an invert at elevation 23.5 NGVD, and 130 LF of 54" diameter CMP culvert into an unnamed preserved wetland via spreader swale. Maximum allowable discharge is 8 cfs.

SFWMD Permit No. 36-01223-S is issued to Lee County Board of County Commissioners for construction and operation of a water management system serving 67 acres of roadway lands (Colonial Blvd. Extension). The property is located along 2.23 miles between Fort Myers and Lehigh Acres and crosses over a portion of Six-Mile Cypress Slough. Drainage will be accommodated by roadside swales and dry detention areas with overflow into surrounding wetland systems. Discharge facilities include:

- 2 - 21' x 4' box culverts
- 2 - 42" CP culverts
- 3 - 24" x 36" ERCP culverts

SFWMD Permit No. 36-01196-S, issued to Six-Mile Cypress Land Trust (Six-Mile Cypress Office Park), authorizes a surface water management system to serve a project and drainage area of 26 acres of commercial lands. The property is located in S4/T45S/R25E, in Lee County. The system consists of a series of inlets and culverts proposed to collect and convey the excess runoff to an on-site 2.6 acre lake. Discharge from the project is via a control structure consisting of a 5.5" diameter bleeder orifice with invert set at elevation 17.0 NGVD. This structure discharges through 36 LF of 15" diameter RCP culvert to a 10' wide spreader swale.

SFWMD Permit No. 36-00546-S, issued to Lee County Bank, Trustee for Georgian Bay, authorizes a water management system for 289.0 acres of residential lands. The property is located in S20,29/T45S/R25E, in Lee County. The site consists of 2 drainage basins (East Basin and West Basin). A system of swales and catch basins will direct runoff to 2 on-site lakes. The lakes will be regulated by 2 control structures discharging into spreader swales directing runoff into 2 wetland areas. The control structure descriptions are as follows:

East Basin: 1 - 1.5' wide weir with crest at elevation 16.6' NGVD and 100 LF of 29" x 45" ERCP culvert. Outfall is to the adjacent wetland area via a spreader swale. 1 - 6" diameter circular orifice with invert at elevation 16.0' NGVD and 650 LF of 14" x 23" ERCP culverts provide bleeddown for the East Basin. Discharge is to the West Basin lake.

West Basin: 1 - 1.5' wide weir with a crest at elevation 16.5' NGVD; 1 - 16.3" wide rectangular notch with invert at elevation 16.0' NGVD; and 70 LF of 29" x 45" ERCP culvert. Outfall is to the adjacent wetlands area via a spreader swale.

SFWMD Permit No. 36-01872-S is issued to P. Gerald DeSimone, Trustee for Omni Interstate Park-Parcel "C". The total project area is 249.4 acres, and contains a 44.0 on-site water management lake. The intended land use is to be primarily commercial/office space. The property is bounded to the east by I-75, to the south by Six-Mile Cypress Slough, to the west by Six-Mile Cypress Parkway, and to the north by Colonial Boulevard, in Lee County. The collection and conveyance of stormwater is accomplished through a series of inlets and culverts which drain into the water management lake. An in-lake control structure (1 - inverted triangle bleeder orifice with an invert at elevation 17.8' NGVD) will detain the water until it discharges into an 800' x 50' spreader swale and out into the Six-Mile Cypress Slough. Allowable discharge is 14.4 cfs.

SFWMD Permit No. 36-01747-S is issued to Ronald C. Francisco of Pro Terra Properties (proposed Southwest Regional Convention Center). The proposed site and drainage area is 52.93 acres and the site is located in central Lee County at the intersection of Chamberlin Highway and Fuel Farm Road. Allowable discharge is 1.8 cfs. A description of discharge facilities is as follows: 1- 3.0" diameter bleeder orifice with an invert at elevation 23.2' NGVD and 12 LF of 15" diameter RCP culvert discharging to a rip-rap spreader swale.

SFWMD Permit No. 36-01729-S (modification) is issued to Lee County Department of Transportation and Engineering for the widening of 0.4 mile of Treeline Road and construction of 0.5 mile of access road. The project lies in a largely undeveloped area near the Southwest Florida Regional Airport in S23,24,19,18/T45S/R26E, near Daniels Parkway in Lee County. Discharge is accomplished by a weir with an invert elevation of 21.3' NGVD, and ditch blocks along the access road. No calculated cfs data was provided.

SFWMD Permit No. 36-01662-S, issued to Leewood Development Corporation, authorizes construction and operation of a surface water management system to serve an 80.33 acre site and drainage area to accommodate a single family residential development known as Woodland Walk. The Lee County property is located in S29/T45S/R25E. The system is divided into 2 basins: Basin A being the most westerly and Basin B encompassing the southeast corner of the property. The discharge facility for Basin A is a 0.25' diameter orifice weir with invert at elevation 16.0' NGVD; the discharge facility for Basin B is a 0.25' diameter orifice weir with invert at elevation 17.0' NGVD. Allowable discharges for the basins are 1.81 cfs and 0.38 cfs, respectively.

4.2.5.2 Agricultural Management Practices

Of 16,407 acres of urban and agricultural acres in the Six-Mile Cypress Slough Basin, 6,543 acres (19%) are in agricultural lands, almost exclusively cropland and pastureland. Agricultural land use

estimates for all major irrigated crops for 1990 in the basin are listed in Table 4-9. Surface water discharge and groundwater withdrawal permits are listed in Table 4-10 and described below.

Table 4-9. 1990 estimated irrigated crop acreages in the Six-Mile Cypress Slough Basin.	
CROP	ACREAGE
Improved pasture	3,298
Row crops	1,025
Field crops	142

Table 4-10. Permitted annual discharges (cfs) and groundwater withdrawals (MG) for the Six-Mile Cypress Slough Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED ANNUAL DISCHARGE/ALLOCATION
Groundwater withdrawal			
<i>36-01634-W</i>	51	Water table aquifer	87.23 MG
<i>36-00117-W</i>	160	Water table aquifer	77.9 MG
<i>36-00089-S/W</i>	282.4	Shallow Aquifer	309.07 MG
<i>36-00115-S/W</i>	50	Surficial Aquifer	26.36 MG
Surface water discharge			
<i>36-00115-S/W</i>	80	-	2.9 cfs
<i>36-00117-S</i>	320	-	9.4 cfs
<i>36-01634-S</i>	79.9	-	6 cfs

SFWMD Permit No. 36-00375-S is applied for by Jane E. Powers (Sadisco) for the purpose of the construction of a water management system serving 18.52 acres of agricultural lands in Lee County, S36/T44S/R25E. The receiving waterbody is Six-Mile Cypress via existing ditches and wetlands. On-site detention, with no discharges, is proposed via grassed swales and a detention pond providing 15 acre-feet of detention. Control structures consist of 1 - 43 degree v-notch bleeder with an invert at elevation 22.3 NGVD.

SFWMD Permit No. 36-00115-S/W is issued to R.E. McMahon (Wood Lease) for the use of groundwater from the Surficial Aquifer for agricultural irrigation serving 50 acres with an annual allocation of 26.36 MG. The property is located in Lee County, S23/T45S/R25E. The permit also

include the operation of a water management system serving 80 acres of agricultural lands by 2 - 5000 gpm pumps discharging into six Mile Cypress watershed. Permitted discharge is 2.9 cfs. Withdrawal facilities consist of 3 - 5" x 15' wells with two-900 gpm portable pumps.

SFWMD Permit No. 36-00089-S/W, issued to Zipperer Farms, Inc. (Buckingham Farm), is for the continuation of withdrawal of up to 309.07 MG annually for agricultural irrigation in S22,26,27/T44S/R25E. Total project acreage is 575, and the total irrigation acreage is 282.4 (73 AC of citrus, 74.4 AC ornamentals, and 135 AC of pasture). Withdrawal sources include surface water from on-site lakes and groundwater from the shallow aquifer. Existing withdrawal facilities are:

- 2 - 6" x 40' x 1,200 gpm wells cased to 20'
- 2 - 6" x 40' x 1,500 gpm wells cased to 20'
- 1 - 8" x 54 HP x 5,000 gpm surface water pump
- 1 - 12" x 25 HP x 10,000 gpm surface water pump

SFWMD Permit No. 36-00117-W is issued to W. S. McJunkin authorizing the continuation of an existing use of groundwater from the water table aquifer for agricultural irrigation serving 160 acres with an annual maximum withdrawal of 77.9 MG. The total project acreage is 320, and is located in S9/T45S/R25E, in Lee County. The existing withdrawal facilities are:

- 1 - 6" x 25' x 700 gpm well cased to 14'
- 1 - 6" x 25' x 700 gpm well cased to 16'

SFWMD Permit No. 36-00117-S is issued to R. E. McMahon (McJunkin Lease) authorizing the operation of a water management system serving 320 acres of agricultural lands by 3 - 5,000 gpm pumps discharging into Six-Mile Cypress. The permittee's allowable discharge is 9.4 cfs, and the property is located in S9/T45S/R25E, in Lee County.

SFWMD Permit No. 36-01634-W is issued to Richmond Powell for the use of groundwater from the water table aquifer for agricultural irrigation serving 51 acres with a maximum annual withdrawal of 87.23 MG. The property is located in S21/T45S/R25E, and withdrawal facilities are:

- 1 - 8" x 40' x 360 gpm well cased to 10"
- 1 - 8" x 40' x 210 gpm well cased to 10"
- 1 - 8" x 40' x 330 gpm well cased to 10"

SFWMD Permit No. 36-01634-S, issued to Richmond Powell, authorizes construction and operation of a water management system serving 79.9 acres of agricultural land. The entire drainage area size is 97.9 acres. The property is located in S21/T45S/R25E. Runoff is directed to a 6.1 acre lake which provides pre-treatment prior to discharging into a 21.9 acre wetland area. Discharge from the

wetland is through a control structure which consists of 1 - 0.9' high by 1.62' wide inverted triangular bleeder with an invert at elevation 17.3 NGVD. Ultimate discharge is to Six-Mile Cypress Basin via a swale and overland sheetflow. Allowable discharge is 6 cfs.

SFWMD Permit No. 36-01634-W is issued to Richmond Powell for the use of groundwater from the water table aquifer for agricultural irrigation serving 51 acres with a maximum annual withdrawal of 87.23 MG. The property is located in S21/T45S/R25E, and withdrawal facilities are:

1 - 8" x 40' x 360 gpm well cased to 10"

1 - 8" x 40' x 210 gpm well cased to 10"

1 - 8" x 40' x 330 gpm well cased to 10"

SFWMD Permit No. 36-01634-S, issued to Richmond Powell, authorizes construction and operation of a water management system serving 79.9 acres of agricultural land. The entire drainage area size is 97.9 acres. The property is located in S21/T45S/R25E. Runoff is directed to a 6.1 acre lake which provides pre-treatment prior to discharging into a 21.9 acre wetland area. Discharge from the wetland is through a control structure which consists of 1 - 0.9' high by 1.62' wide inverted triangular bleeder with an invert at elevation 17.3 NGVD. Ultimate discharge is to Six-Mile Cypress Slough Basin via a swale and overland sheetflow. Allowable discharge is 6 cfs.

4.3 Mullock Creek

The Mullock Creek Basin includes less than 7,000 acres of the Estero Bay Watershed in coastal Lee County. The basin extends from Estero Bay east along the length of Mullock Creek, north to Alico Road and east to Three Oaks Parkway, just west of I-75. Although residential areas occur over much of the basin, it is largely undeveloped west of S.R. 41.

4.3.1 Topography

There is much greater variation in topography in the Mullock Creek Basin when compared with Cow and Hendry Creek Basins to the north and west. Elevations in the Mullock Creek Basin range from sea level to about 5 feet NGVD west of S.R. 41. From S.R. 41 east to I-75, elevations increase to more than 20 feet NGVD. Upland forests occur at the higher elevations along the west side of S.R. 41, while wetlands occur throughout the lower elevations along the coast and are associated with Estero Bay and Mullock Creek.

4.3.2 Soils

Like topography, variation in soil type is also greater in the Mullock Creek Basin when compared with the lower-lying Cow and Hendry Creek basins. Soils are composed of the coastal Holocene

sediments and undifferentiated shell beds in the interior portion of the basin. Anthropogenically altered or arent soils, e.g., dredge and fill, shell mounds, and landfills are also included within the basin.

Soils of the Mullock Creek Basin are primarily Peckish-Estero Isles soils characteristic of tidal areas and barrier islands. These soils are nearly level, very poorly drained, and mucky, although some have a sandy, organic-stained subsoil and some have a loamy subsoil. The interior portion of the basin where development has occurred includes Immokalee-Pompano soils characteristic of flatwoods and sloughs.

The majority of the individual soils series within the 6,787 acres of mapped soils in the basin have been assigned an HSG value of D (Plate 4-5). These soils total approximately 5,997 acres (Table 4-11). HSG-designated D soils have very slow infiltration rates when thoroughly wetted, thus, the runoff within the basin is expected to be high. These soils are primarily clay with a high permanent water table or shallow soils over nearly impervious materials, such as a clay pan or clay layer.

The remaining soils are designated as HSG A, B, and C and have low to high runoff potential. These are the more interior soils with slow infiltration rates when thoroughly wetted, often with a layer of soil that impedes the downward movement of water. These soils make up only 11% of the soil types in the basin. A, B, and C designated soils are conspicuously associated with development, including S.R. 41 and Alico Road construction, and the San Carlos Park golf course, as well as agricultural uses to the east of S.R. 41.

Table 4-11. Hydrologic soil groups in the Mullock Creek Basin.		
HYDROLOGIC SOIL GROUPS	AREA (acres)	PERCENT COVER
A	219	3%
B	213	3%
C	358	5%
D	5,997	88%
TOTAL	6,787	100%

4.3.3 Existing Land Use

Existing land use acreages for the Mullock Creek Basin are presented in Table 4-12. A map of existing land use for the basin is presented in Plate 4-6. Unlike the upper basins (Cow and Hendry

creeks) in which land use is primarily undeveloped, the Mullock Creek Basin is 62% (4,377 acres) developed land use and only 37% (2,618 acres) undeveloped. Thirty-seven percent of the total basin land use is in medium density residential and covers most of the basin east of S.R. 41. The community of San Carlos Park makes up most of the residential area in the basin. Two large golf communities make up most of the recreation and open lands in the basin (395 acres) and are located among the residential areas east of I-75. A few small commercial areas are concentrated along Alico Road and Three Oaks Parkway.

Small areas of agricultural (484 acres, 7%) are concentrated primarily in the northeast and southeast corners of the basin and a smaller area to the west of S.R. 41 and south of Mullock Creek. Agricultural uses are predominantly cropland and pastureland.

Undeveloped areas are located almost exclusively west of S.R. 41. Over fifteen hundred acres of undeveloped land cover occurs as wetlands (23% of the basin land use), predominantly wetland hardwood forests (1,350 acres). Upland forested areas cover an additional 15% of the basin (1,040 acres). Water, including streams, sloughs, reservoirs, lakes, and bays and estuaries, composes less than 100 acres (1%) in the basin. Water is associated with the creek itself, and small sloughs and recreation areas in the basin.

A discrepancy in total acres between soils and land use occurs as a result of the water associated with the European Townhouse community at the juncture of S.R. 41 and Alico Road. This area is designated as water in the soils map and disturbed land on the land use map due to its former use as a borrow pit during construction of S.R. 41 and Alico Road.

Table 4-12. Land use and land cover for the Mullock Creek Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Residential		
Residential Low Density	93	1%
Residential Medium Density	2,565	37%
Residential High Density	95	1%
Residential - Mobile Homes	130	2%
Subtotal	2,883	41%
Commercial/ Industrial		
Commercial and Services	32	<1%
Industrial	184	3%
Institutional	44	1%
Subtotal	260	4%
Barren Land		

Table 4-12. Land use and land cover for the Mullock Creek Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Disturbed Lands	145	2%
Subtotal	145	2%
Recreation and Open Land		
Recreational	300	4%
Open Land	95	1%
Subtotal	395	6%
Transportation and Utilities		
Transportation	69	1%
Utilities	46	1%
Subtotal	115	2%
Agriculture		
Cropland and Pastureland	423	6%
Shrub and Brushland	61	1%
Subtotal	484	7%
TOTAL DEVELOPED LANDS	4,377	62%
Upland Forested		
Upland Coniferous Forests	777	11%
Upland Hardwood Forests	163	2%
Upland Hardwood Forests	100	1%
Subtotal	1,040	15%
Wetlands		
Wetland Coniferous Forests	36	1%
Wetland Hardwood Forests	1,350	19%
Vegetated Non-Forested Wetlands	192	3%
Subtotal	1,578	23%
TOTAL UNDEVELOPED LANDS	4,377	62%
Water		
Streams and Waterways	15	<1%
Lakes	5	<1%
Reservoirs	13	<1%
Bays and Estuaries	16	<1%
Slough Waters	46	1%
Subtotal	95	1%

Table 4-12. Land use and land cover for the Mullock Creek Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
TOTAL	6,995	100%

4.3.4 Geologic and Drainage Features

The Mullock Creek Basin is characterized by surface and subsurface drainage features that interact with each other. There is a network of canals in the basin which provide stormwater and groundwater drainage for residential areas, which makes up 40% of the basin land use. Approximately 20% of the basin is made up of undeveloped wetlands. The existing geologic and drainage systems are discussed in the following sections.

4.3.4.1 Hydrogeology

There are three major aquifer systems underlying the Estero Bay Watershed, including the Mullock Creek Basin. These are the:

- ! Surficial Aquifer System,
- ! Intermediate Aquifer System, and
- ! Floridan Aquifer System.

The Surficial Aquifer is the uppermost aquifer and includes the water table aquifer, confining beds, and the lower Tamiami aquifer; the water table aquifer and the lower Tamiami aquifer are the two main water bearing formations. The water table aquifer is an unconfined aquifer of primarily undifferentiated sands, shell beds, calcareous clays, and some limestone. The semi-confining Tamiami confining zone separates the water table aquifer from the Lower Tamiami Aquifer.

The Surficial Aquifer is the most significant aquifer system since it is the closest to the surface and is at times in direct connection with surface water. The potentiometric surface of this aquifer follows land surface contours and for undrained areas, wet season water levels are seldom less than 3 feet above or below land surface. The water level in the water table aquifer in the Mullock Creek Basin ranges from 0 feet NGVD in the coastal portions of the basin to approximately 15 feet NGVD along the eastern watershed boundary (SFWMD, 1990).

Thickness of the Surficial Aquifer varies between 25 and 50 feet in central Lee County to and thickens toward the southeastern part of Lee County. Movement in the Surficial Aquifer is generally southwest and provides water for baseflow for major streams and rivers in the watershed.

In areas where the underlying Hawthorn confining zone is thin or absent the Surficial Aquifer is in direct hydraulic connection with the Sandstone Aquifer. The upper Hawthorn confining zone separates the Surficial aquifer from the Sandstone Aquifer in most of Lee County and ranges from 0 to 25 feet below the surface in the central portion of the watershed and the thickness decreases farther south and is absent near Bonita Springs.

The Intermediate Aquifer, also called the Hawthorn Aquifer, lies below the Surficial Aquifer and is comprised of the five major units listed below. The two water producing zones of this system are the Sandstone and Mid-Hawthorn aquifers (SFWMD, 1982).

- ! Upper Hawthorn Confining Zone,
- ! Sandstone Aquifer,
- ! Mid-Hawthorn Confining Zone,
- ! Mid-Hawthorn Aquifer, and
- ! Lower Hawthorn/Tampa Confining Zone.

The Floridan Aquifer underlies all of Florida. The top of the Floridan Aquifer is associated with the lower Hawthorn Formation and the Tampa Formation, the top of which ranges from -350 feet in northwestern Lee County to -700 feet in the southern portion of the county. The potentiometric surface of the Mid-Hawthorne Aquifer ranges from 10 feet NGVD along the coastal portion of the Mullock Creek Basin to approximately 30 feet NGVD along the eastern boundary.

The Sandstone Aquifer underlies the upper Hawthorn confining zone throughout nearly the entire watershed. The top of this unit occurs between 0 to 15 feet NGVD from the coastal areas to the northeastern boundary in the Mullock Creek Basin in Lee County (SFWMD, 1990). In the northern part of the Estero Bay Watershed it is between 25 and 50 feet NGVD, but it dips in a southerly direction to 150 feet below the surface in the southeastern portion of Lee County.

The Tamiami and Hawthorn formations are approximately 40-580 feet in thickness in Lee County. The lower Tamiami Formation ranges from 0 (coastal) to 12 feet (eastern boundary) NGVD in the Mullock Creek Basin. These formations occur as limestones and dolomites and serve as reservoirs for the Tamiami and upper Hawthorn aquifers which supply freshwater. The lower Hawthorn Aquifer water supply is highly saline (SWRPC, 1995).

4.3.4.2 Surface Drainage

Surface drainage is dependent on groundwater levels, rainfall, and the drainage network characteristics. Groundwater inflows and rainfall are inputs to the surface water hydrologic system,

whereas the drainage network controls the output. The surface drainage of the Mullock Creek Basin is discussed here.

Surface waters in the southern portion of the Mullock Creek Basin and east of US 41 flow west under US 41 and are conveyed north along US 41 to Estero Bay. Surface waters west of US 41 flow west directly into Estero Bay. The basin east of US 41 includes community of San Carlos Park, which is drained by canals and creeks into Mullock Creek and under US 41 to the bay

4.3.5 Management Practices

Approximately 62% of the Mullock Creek Basin is classified as urban and agricultural lands (Table 4-12). The discussion of urban management practices is divided into urban water uses and urban water discharges. The water uses and water discharges are tabulated in the following descriptions.

4.3.5.1 Urban Management Practices

Forty-one percent (2,883 acres) of the Mullock Creek Basin is classified as residential land use, 6% (395 acres) is classified as recreation and open areas, and 4% (260 acres) is commercial and industrial. The urbanized areas of the basin are found primarily in the communities located in the northern and northwestern portions of the basin. Permitted discharges to Mullock Creek are almost exclusively residential and commercial surface water management discharges and those with permitted discharges are listed Table 4-13. Summaries of permitted water management activities, based on SWFWMD permit files, follow.

Table 4-13. Surface water discharges (cfs) permitted in the Mullock Creek Basin.		
PERMIT NUMBER	ACRES SERVED	ANNUAL PERMITTED DISCHARGE (cfs)
<i>36-01036-S</i>	3.63	0.4
<i>36-00226-S</i>	16	5
<i>36-00226-S</i>	20	4
<i>36-00478-S</i>	280.3	50
<i>36-00155-S</i>	38.6	26

SWFWMD Permit No. 36-00633-S is issued to Southpark Woods, James Chitwood owner for a modification to the stormwater management system to increase impervious area within the residential parcel from 1.98 acres to 3.52 acres, reduce the impervious area in the commercial parcel to 2.96 acres, and increase dry retention area to 1.85 acres. Located in S7/T46S/R25E, this 48 unit multi-family project with ancillary commercial was permitted in October 1987. Total land area is

16.14 acres. Drainage facilities include 1.85 acres of dry retention, one special inlet with a grate, one 6" diameter orifice, and approximately 75 linear feet of 18" diameter RCP culvert.

SFWMD Permit No. 36-00372-S is issued to Bellaire Subdivision, Richard Allaire developer for the surface water management system for a 37 unit single family subdivision on 23.4 acres. Located in Lee County, S20/T46S/R25E, this single family subdivision includes 4.0 acres of surface water detention. Wastewater treatment is provided by septic tank. Drainage facilities include grassy swales leading to a 30" wide drainage easement which discharges into the existing 1.2 acre detention lake. Discharge from the lake will be over 1-2.7' wide weir with a crest elevation of 10.25 feet NGVD and through 25 linear feet of 18" diameter RCP culvert into a 6.0 foot wide outfall swale which allows discharge into a natural wetland area and finally into Mullock Creek. The lake will bleed down via 40 linear feet of 4" diameter PVC pipe with an invert elevation of 6.75 feet NGVD.

SFWMD Permit No. 36-00253-S is issued to Coastland Corporation of Florida for the construction of a surface water management system. Located at S9/T46S/ R25E, this surface water management system serves a 76 acre residential project. Wastewater management is provided by the San Carlos Utility Company. Drainage facilities included a 7.2 acre retention lake and canals. A system of canals, swales, inlets and culverts will collect runoff and direct flow to a 3.2 acre lake. Discharge will occur to an East Mullock Drainage District Canal, via 1-2.5 foot weir with crest at 13.5 feet NGVD and 50 linear feet of 30 inch RCP.

SFWMD Permit No. 36-00145-S is issued to San Estero Center. This permit modifies one issued for a surface water management system for a 85,510 square foot commercial land use. Located in Lee County S17/T46S/R25E, north of Sanibel Boulevard, East of U.S. 41, this 19.3 acre project provides for 2.9 acres of retention in a pond and grassed swales. The purpose of this modification is to approve construction of a 1.35 acre phase and to modify the conceptual approval by increasing the water management system from 2.5 acres to 2.9 acres, and relocating the outfall structure. Drainage structures include 1-1.6' wide weir, 1-3.0" diameter circular orifice with and invert at elevation 9.0' NGVD, 275 feet of 30" x 10" ERCP culvert, and 30 linear feet of 1' diameter PVC culvert. Discharge is to East Mullock Creek via the U.S. 41 ditch. Permitted discharge elevation is 9.0 feet.

SFWMD Permit No. 36-00664-S is a surface water management permit issued for the Woodbriar Subdivision in Lee County. This 20.38 acre project is located in Lee County S9/T46S/R25E. Surface water is directed to a 2.0 acre on-site lake. Discharge is via a 9.5" diameter orifice with an invert at elevation 14.0 feet NGVD and 328 linear feet of 19"x 30" ERCP culvert to an existing drainage ditch along the south property line. Final discharge is to the Imperial River.

SFWMD Permit No. 36-00458-S is issued to Alico, Inc., for a project in Lee County S7,8/T46S/R26E for the construction of berms and installation of culverts in order to improve

sheetflow to a cypress stand south of Alico Road. This permit modifies the existing conditions which include five 54 inch diameter RCP culverts installed under Alico Road, and an illegal ditch/dike excavated along the eastern section line. Drainage facilities approved by this permit include: Construct a berm with culverts and flap gates near the eastern section line of S8/T46S/R26E. The berm will prevent any high water condition caused by opening the Alico Road culverts. The berm is approximately 2.0' in elevation with a top width of 5". Five 18" diameter CMP culverts, with flap gates will be installed through the berm with inverts at existing ground elevation.

SFWMD Permit No. 36-01036-S is issued to the Lee County Division of Parks and Recreation for a roadside swale south of Sanibel Boulevard approximately one mile east of U.S. 41. The project area was part of an existing 3.63 acre parks department site consisting of one small building and adjacent parking area. The proposed project will consist of a pool, deck area, bathhouse, and an enlarged parking lot. In total 0.95 acres of the 3.63 acre site is impervious. Drainage facilities include a system of inlets and pipes directing runoff into a 0.18 acre dry detention area which discharges into an existing roadside swale. Allowable discharge 0.4 cfs.

SFWMD Permit No. 36-00226-S is issued to Florida Suncoast Home Corp. for a 16 acre residential land use located in S17/T46S/R25E. Surface water management system includes grassy swales, and a 1.36 acre on-site lake with a discharge to the East Mullock Drainage District's Canal. Drainage facilities include a system of grassy swales, inlets and culverts, an on-site lake, a 12' weir and one 15" culvert 50 linear feet discharging to the East Mullock Drainage District's Canal. Allowable discharge is 5 cfs.

SFWMD Permit No. 36-00226-S is issued to Betty Gillespie, Trustee for a 20 acre residential land use located in Lee County, S9/T46S/R25E. The permit is a modification of a previous permit to revise weir crest and control structure elevations. Drainage facilities include 1-special inlet with 1-0.5' wide weir, 1-4" diameter bleed down orifice, 108 linear feet of 15" culvert to the East Mullock Drainage District Canal. Allowable discharge is 4 cfs. Utilities provided by San Carlos Utilities.

SFWMD Permit No. 36-00478-S is issued to The Vines County Club, located in Lee County east of U.S. 41 and south of San Carlos Park in S21/T46S/R25E. This surface water management permit is for Phase II of the 280.3 acre residential project. Drainage facilities include a system of hydraulically connected lakes. Discharge is through 1- 7.0' wide weir with a crest at elevation 13.0 feet NGVD; 1- 2.7' wide 85 degree V-notch bleeder. Outfall is via 40 linear feet of 4' x 6' box culvert to an existing ditch then to Mullock Creek. Allowable discharge is 50 cfs. Utilities provided by Gulf Utility Company.

SFWMD Permit No. 36-00408-S is issued to Caloosa Trace Homeowner's Association, Inc. Project is located in Lee County S9/T46S/R25E, south of Alico Road approximately 2 miles east of U.S. 41. This surface water permit is for the construction and operation of San Carlos Park, consisting of 4.1

acres and the redesign of the previously authorized 36 acre Caloosa Trace project. Drainage facilities include two control structures; Control structure one has 1-3.0 foot wide weir, 1-70 degree V-notch bleeder, and 50 linear feet of 30" culvert. Control structure two has 1-3.0' wide weir 1-70 degree V-notch bleeder, and 50 linear feet of 30" culvert. Both structures discharge to the East Mullock Drainage District Ditch and then to Mullock Creek.

SFWMD Permit No. 36-00155-S is issued to Andemeli Land and Development Company, Inc. for a residential project located in Lee County S15/T46S/R25E. This permit modifies an existing approval and authorizes construction of a surface water management system for a 38.6 acre residential land use. Drainage facilities include a 28" x 20' culvert, and a 4.5' wide weir with a 4 inch diameter bleeder slot. Allowable discharge is 26 cfs. Receiving waterbody is the East Mullock Drainage District Canal.

SFWMD Permit No. 36-02051-S is issued to Palmetto Kay for the construction of a 25.96 acre commercial project. The project is located in Lee County, south of Summerlin Road west of Bass Road in S4/T46S/R24E. The surface water system consists of a 5.2 acre wet detention area with dry pretreatment provided within individual lots. Drainage facilities include 1-4" wide weir and a 58 degree notch bleeder. The permit requires the creation of a 2.26 acre marsh, and the enhancement of 2.4 acres of mangrove wetlands.

4.3.5.2 Agricultural Management Practices

Only approximately 7% (484 acres) of the Mullock Creek Basin includes agricultural land uses. These agricultural uses are predominantly improved and unimproved pasturelands. Estimated agricultural irrigation, based on major irrigated crops for 1990, include 164 acres of improved pasturelands. Agriculture in the basin also includes 258 acres of non-irrigated, unimproved pasture. No agricultural water use permits were found in the SFWMD permit files.

4.4 Estero River

The Estero River Basin includes 45,381 acres in the Estero Bay Watershed in Lee County. The basin extends northeast from Estero Bay, sharing its western boundary with the Spring Creek Basin until it reaches S.R. 82. Both S.R. 41 and I-75 are major north-south transportation corridors in the eastern half of the basin. Another major feature in the Estero River Basin is the newly established Gulf Coast University, located just east of I-75 between Alico and Corkscrew roads.

4.4.1 Topography

Elevations in the Estero River Basin range from sea level along Estero Bay to more than 35 feet NGVD in some places along the northern most boundary at S.R. 82. Agriculture and upland forest

occur at the higher elevations, while wetlands occur at the lower elevations associated with the river and sloughs.

4.4.2 Soils

Soils of flatwoods and sloughs dominate the Estero River Basin. These soils are primarily of the Oldsmar-Malabar-Immokalee and Immokalee-Myakka type and are nearly level, poorly drained, deep sandy soils with some organic material. Soils along the lower Estero River are sandier and more shallow and include Hallandale-Boca and Immokalee-Pompano soils. Isles-Boca-Pompano soils characterize many of the sloughs; these soils are depressional soils and the water table is above the surface for 3-6 months of the year. A small area of Peckish-Estero Isles soils, characteristic of tidal areas and barrier islands, occurs along the coast of the basin, south to Spring Creek.

In general, most of these soils are composed of the coastal Holocene sediments and undifferentiated shell beds in the interior portion of the Estero Bay Watershed. Anthropogenically altered or arent soils, e.g., dredge and fill, shell mounds, and landfills also occur in the basin.

Less than 5% of the soils in the watershed are classified as very well-drained, well drained, to less well-drained (HSG designations A, B, and C), while 96% are classified as D (poorly drained) (Table 4-14). The drainage characteristics and associated vegetation of the soils within the Estero Bay Watershed were described previously in Section 2.4. This section presents the detailed USDA/SCS soil information as compiled in a GIS database for the Estero Bay Watershed. This information has been combined with updated 1995 land use data in order to model surface water hydrology for the basin.

The majority of the individual soils series within the 44,679 acres of mapped soils in the basin have been assigned an HSG value of D (Plate 4-7). These soils total approximately 42,199 acres (Table 4-14) and make up 94% of the soils in the watershed. HSG-designated D soils have very slow infiltration rates when thoroughly wetted, thus, the runoff within the basin is expected to be high. These soils are primarily clay with a high permanent water table or shallow soils over nearly impervious materials, such as a clay pan or clay layer.

The remaining soils are designated as groups A, B, and C and have low to high runoff potential. These are the more interior soils with slow infiltration rates when thoroughly wetted, often with a layer of soil that impedes the downward movement of water. These soils make up only 4% of the soil types in the basin. A, B, and C designated soils are associated with a former quarry just east of I-75 and south of Alico Road as well as a small residential area and upland forest west of S.R. 41.

Table 4-14. Hydrologic soil types in the Estero River Basin.		
HYDROLOGIC SOIL GROUP	AREA (acres)	PERCENT COVER
A	667	1%
B	119	<1%
C	1,694	4%
D	42,199	94%
Total	44,679	100%

4.4.3 Existing Land Use

Existing land use acreages for the Estero River Basin are presented in Table 4-15. A map of existing land use for the basin is presented in Plate 4-8. Land uses classes listed in both the table and map are grouped as developed (urban and agriculture), undeveloped (natural land cover), and water.

Developed land use includes 19,474 (43%) acres of the Estero Bay Watershed, compared with 25,571 acres (56%) of undeveloped/natural land cover. Similar to the Mullock Creek Basin, the single largest developed land use in the basin is agriculture; in the Estero River Basin, agriculture is also the largest single land use category overall. There are 10,612 acres of cropland and pasture in the basin, making up a quarter of the overall land use in the basin. The only other developed land use class comprising more than 4% of the overall basin was 2,444 acres (5%) extractive category, which is conspicuous in its size.

Commercial/industrial, recreation and open lands, and transportation and utilities land use classes individually comprise less than 4% of the basin. All four residential land use categories amounted to only 6% (2,564 acres) of the overall basin land use (3,080 acres), most of which is associated with the small communities of Country Creek, Corkscrew Woodlands, and Estero Springs.

Nearly one-third of the basin is undeveloped and these areas are associated pine uplands as well as with the many cypress wetlands in the basin. Wetland forested areas cover about a third of the basin overall and 8,519 acres (19%) of wetland coniferous forests (cypress wetlands) make up the largest undeveloped land use in the Estero River Basin. Wetlands are predominantly cypress swamps, compared with wetland hardwood forests of the lower coastal basins. Upland forested areas include 10,163 acres (22%) of the natural areas in the basin and are scattered through the basin.

Water occurs primarily as reservoirs and sloughs and makes up only 336 acres (1%) of the basin. Water is primarily associated with sloughs and drainage impoundments scattered throughout the

basin. These areas result in the discrepancy in total acres between soils and land use as a result of the area being designated as water in the soils map and disturbed land on the land use map.

Table 4-15. Land use and land cover for the Estero River Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Residential		
Residential Low Density	1,567	1%
Residential Medium Density	556	3%
Residential High Density	158	1%
Residential - Mobile Homes	283	<1%
Subtotal	2,564	6%
Commercial/Industrial		
Institutional	112	<1%
Industrial	46	<1%
Subtotal	158	<1%
Barren Land		
Extractive	2,444	3%
Disturbed Lands	1,454	5%
Subtotal	3,898	9%
Recreation and Open Land		
Recreational	896	2%
Open Land	1,303	4%
Subtotal	2,199	6%
Transportation and Utilities		
Transportation	475	1%
Utilities	310	1%
Subtotal	785	2%
Agriculture		
Cropland and Pastureland	10,612	23%
Tree Crops	95	<1%
Nurseries and Vineyards	84	<1%
Subtotal	10,791	24%
TOTAL DEVELOPED LANDS	16,407	47%
Shrubland and Brushlands	1,011	2%
Upland Forested		
Upland Coniferous Forests	9,348	21%

Table 4-15. Land use and land cover for the Estero River Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Upland Hardwood Forests	725	1%
Tree Plantations	90	<1%
Subtotal	10,163	22%
Wetlands		
Wetland Coniferous Forests	8,519	19%
Wetland Hardwood Forests	2,861	6%
Vegetated Non-Forested Wetlands	2,230	5%
Wetland Forested Mixed	787	2%
Subtotal	14,397	32%
TOTAL UNDEVELOPED LANDS	24,560	54%
Water		
Reservoirs	233	1%
Streams and Waterways	4	<1%
Lakes	7	<1%
Bays and Estuaries	7	<1%
Slough Waters	85	<1%
Subtotal	336	12%
TOTAL	45,381	100%

4.4.4 Geologic and Drainage Features

The Estero River Basin is characterized by surface and subsurface drainage features that interact with each other. There is a network of canals in the basin which provide stormwater and groundwater drainage for agricultural areas, which makes up 24% of the basin land use. Approximately 32% of the basin includes undeveloped wetlands. The existing geologic and drainage systems are discussed in the following sections.

4.4.4.1 Hydrogeology

There are three major aquifer systems underlying the Estero Bay Watershed, including the Estero River Basin. These are the:

- ! Surficial Aquifer system,

- ! Intermediate Aquifer System, and
- ! Floridan Aquifer System.

The Surficial Aquifer is the uppermost aquifer and includes the water table aquifer, confining beds, and the lower Tamiami aquifer; the water table aquifer and the lower Tamiami aquifer are the two main water bearing formations. The water table aquifer is an unconfined aquifer of primarily undifferentiated sands, shell beds, calcareous clays, and some limestone. The semi-confining Tamiami confining zone separates the water table aquifer from the Lower Tamiami Aquifer.

The Surficial Aquifer is the most significant aquifer system since it is the closest to the surface and is at times in direct connection with surface water. The potentiometric surface of this aquifer follows land surface contours and for undrained areas, wet season water levels are seldom less than 3 feet above or below land surface. The water level in the water table aquifer and Lower Tamiami Aquifer in the Estero River Basin range from 4 feet NGVD in the westernmost portions of the basin to 24 feet NGVD along the northeastern watershed boundary.

Thickness of the aquifer varies between 25 and 50 feet in central Lee County to and thickens toward the southeastern part of Lee County. Movement in the Surficial Aquifer is generally southwest and provides water for baseflow for major streams and rivers in the watershed.

A coral reef aquifer extends into southern Lee County from Collier County at shallow depths. In areas where the underlying Hawthorn confining zone is thin or absent the Surficial Aquifer is in direct hydraulic connection with the Sandstone aquifer. The upper Hawthorn confining zone separates the Surficial Aquifer from the Sandstone Aquifer in most of Lee County. It is 0 to 25 feet below NGVD in the central portion of the watershed and the thickness decreases farther south and is absent near Bolita Springs.

The Intermediate Aquifer, also called the Hawthorn Aquifer, lies below the Surficial Aquifer and is comprised of the five major units listed below. The two water producing zones of this system are the Sandstone and Mid-Hawthorn aquifers (SFWMD, 1982).

- ! Upper Hawthorn Confining Zone,
- ! Sandstone Aquifer,
- ! Mid-Hawthorn Confining Zone,
- ! Mid-Hawthorn Aquifer, and
- ! Lower Hawthorn/Tampa Confining Zone.

The Floridan Aquifer underlies all of Florida. The top of the Floridan Aquifer is associated with the lower Hawthorn Formation and the Tampa formation, the top of which ranges from -350 feet in northwestern Lee County to -700 feet in the southern portion of the county. The potentiometric surface of the Mid-Hawthorne Aquifer ranges from 20 feet NGVD along the coastal portions of the Estero River Basin to approximately 40 feet NGVD along the northeastern boundary.

The Sandstone aquifer underlies the upper Hawthorn confining zone throughout nearly the entire watershed. The top of this unit occurs between 5 and 40 feet NGVD from the coastal areas to the northeastern boundary in the Estero River Basin in Lee County (SFWMD, 1990). In the northern part of the watershed it is between 25 and 50 feet NGVD, but it dips in a southerly direction to -150 feet below the surface in the southeastern portion of Lee County.

The Tamiami and Hawthorn formations occur approximately 40-580 feet in thickness in Lee County. These formations occur as limestones and dolomites and serve as reservoirs for the Tamiami and upper Hawthorn aquifers which supply freshwater. The lower Hawthorn Aquifer water supply is highly saline (SWRPC, 1995).

4.4.4.2 Surface Drainage

Surface drainage is dependent on groundwater levels, rainfall, and the drainage network characteristics. Groundwater inflows and rainfall are inputs to the surface water hydrologic system, whereas the drainage network controls the output. The rainfall and surface drainage of the Estero River Basin are discussed here.

The Estero River Basin is drained by the Estero River, and other small drainage conveyances, into central Estero Bay.

4.4.5 Management Practices

Approximately 45% of the Estero River Basin is classified as urban and agricultural lands (Table 4-14). The urbanized areas of the basin are dispersed throughout the basin. The discussion of urban management practices is divided into urban water uses and urban water discharges. The water uses and water discharges are listed in the following descriptions.

4.4.5.1 Urban Management Practices

Only six percent (2,564 acres) of the land use in the Estero River Basin is made up of residential land use. Of 16,407 acres of urban and agricultural acres (47%) in the Six-Mile Cypress Basin, 3080 acres (9%) are residential. Recreation and open lands and commercial and industrial land uses each make up 8 -10% of the land use in the basin.

Table 4-16 lists the surface water discharges permitted in the basin and any permitted withdrawals. Descriptions of permitted discharges and groundwater withdrawals are summarized below. Permitted activities are primarily for residential and commercial uses in the basin.

Table 4-16. Permitted surface water discharges (cfs) and groundwater withdrawals (MG) permitted in the Estero River Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED ANNUAL DISCHARGE/ WITHDRAWAL
Surface water discharge			
<i>36-01901-S</i>	75	-	1.2 cfs
<i>36-01685-S</i>	43.93	-	34.5 cfs
<i>36-01064-S</i>	47.5	-	5 cfs
<i>36-00306-S</i>	77.8	-	40 cfs
<i>36-00300-S</i>	38.3	-	5 cfs
<i>36-00116-S</i>	46	-	10 cfs
<i>36-00621-S</i>	-	-	7 cfs
<i>36-00735-S</i>	283.0	-	31 cfs
<i>36-00491-S</i>	107	-	2 cfs
Groundwater withdrawal			
<i>36-00676-SW</i>	26	Surficial Aquifer	29.7 MG

Water use and surface water management permits within the basin have been issued as follows:

SFWMD Permit No. 36-02319-S is a modification to the surface water management system serving 16.3 acres of highway development known as Corkscrew Road improvements in Lee County S25,26,35,36/T46S/R25E. The road section is generally located east of I-75. Drainage facilities include drainage swales, two ditch blocks in the swales with weir crest elevations of 15.5' NGVD and a 5" bleeder, replacing 13 existing culverts. The project impacts 0.3 acres of wetlands and preserves 0.4 acres. Final discharge from roadside swales is to the Estero River. No allowable discharge volume addressed in the permit.

SFWMD Permit No. 36-01933-S is a surface water management system permit serving 158.8 acres of residential land use. The project is located in Lee County S16/T46S/R26E. Drainage facilities include one 3" wide weir with crest elevation 23.4' NGVD, one-34.7' V-notch bleeder with invert at elevation 23.0' NGVD and 220 LF of 18" culvert discharging to the Alico Road ditch. Receiving waterbody is the Estero River via Alico Road ditch and overland flow.

SFWMD Permit No. 36-01901-S is issued to Corkscrew Ranch for a surface water management system permit serving 75 acres of residential land uses located in Lee County S21/T46S/R26E. Drainage facilities include three basins. Basin A has one 4.0" diameter bleeder orifice with an invert

elevation 20.5' NGVD, one 6.0" diameter orifice and 45 LF of 15" culvert and 20 LF of rip-rap spreader swale. Basin A allowable discharge is 1.7 cfs. Basin B has one 4.0" diameter bled orifice with an invert elevation of 19.5' NGVD, one 5.5' diameter orifice with an invert at elevation 21.0' NGVD, and 20 LF of 15" culvert and 20 LF of rip-rap spreader swale. Basin B allowable discharge is 1.3 cfs. Basin C has one 3.0" diameter bleeder orifice with an invert at 19' NGVD, one 5.5" diameter orifice and 20 LF of 15" culvert to outfall. Discharge is to the Estero River via spreader swales. Basin C allowable discharge is 1.2 cfs.

SFWMD Permit No. 36-01807-S is issued to Timberland & Tiburow for a surface water management system permit serving 244.5 acres of residential lands in Lee County S25,26/T46S/R25E. Drainage facilities include three lakes totaling 100.07 acres. Discharge to the Estero River via overland flow and FDOT ditch.

SFWMD Permit No. 36-01685-S is issued to Corkscrew Pines for a surface water management permit in Lee County S25,35/T46S/R25E. The permit serves 43.93 acres of residential lands and conceptually approves a surface water management system serving 844.07 acres of additional residential lands within the Corkscrew Pines PUD. Drainage facilities include two lakes. Basin 1 has one 2.25' wide rectangular weir with a crest at 16.8' NGVD and 160 LF of 30" culvert. Basin 2 has a 2.75' wide rectangular weir with a crest elevation of 16.8' NGVD and 325 LF of 36" culvert. Allowable discharge from Basin 1 is 27.9 cfs. Basin 2 allowable discharge is 34.5 cfs.

SFWMD Permit No. 36-01064-S is issued to Corkscrew Center for a surface water management system in Lee County S25,35/T46S/R25E, more specifically described as being located north of Corkscrew Road immediately west of I-75. The permit serves a 47.5 acre residential and commercial land use. Drainage facilities include 3.5 acre feet of wet and dry detention, one 0.5 ' wide weir with a crest elevation of 14.5' NGVD and one 0.5' wide inverted triangle bleeder discharging through 76 LF of 24" culvert. The system discharges to the Estero River via existing roadside swales. Allowable discharge is 5 cfs.

SFWMD Permit No. 36-00338-S is issued to Corkscrew Woods for a surface water management system located in Lee County S35/T46S/R25E, more specifically described as being located south of Corkscrew Road, west of I-75. The permit is for a 180 acre project including 124.9 acre of residential in Phase I and 55.1 acre in Phase II. Drainage facilities include diversion of the predevelopment off-site flow from 48 square miles of drainage basin through 420 LF of 5' x 14' culvert and 88 LF of ditch to the Estero Bay. Eight 200 gpm pumps will be installed in 10 inch slotted pipe. Pumps will turn on at elevation 14' NGVD and turn off at 10 - 12 feet. Discharge is routed to either a 20 acre lake or a 48 acre vegetated area. Discharge is to the Estero River. No allowable discharge provided.

SFWMD Permit No. 36-00331-S is issued to Sweetwater Ranch Access Road for a surface water management system located in Lee County S3,4,9,10/T46S/R25E. Drainage facilities for this 2,485

LF road include grassed roadside swales and 4-18", 1-24" and 1-24" existing culverts with total on-site retention.

SFWMD Permit No. 36-00306-S is issued to Riverwoods Plantation for a surface water management system in Lee County S29/T46S/R25E. Permit serves a 77.8 acre residential land use. Drainage facilities include three 3.5' wide weirs, with 95 degree bleeder notch. Discharge is to the Estero River via grassy swales. Allowable discharge is 40 cfs.

SFWMD Permit No. 36-00300-S is issued to Cypress Bend R.V. Park for a surface water management system located in Lee County S28/T46S/R25E. Project is a 38.3 acre recreational R.V. park. Drainage facilities include wet and dry detention, one 25' weir and one 6" diameter bleeder orifice. Outflow to the Estero River via FDOT drainage ditch. Allowable discharge is 5 cfs.

SFWMD Permit No. 36-00116-S is issued to Grandrook Harbor for a surface water management system located in Lee County S29/T46S/R25E. Project is a 46 acre residential land use. Drainage facilities include 3.5 acres of drainage easement and detention areas, a 7.6' long weir with a 3" bleeder notch, a second 1.4' long weir and a 3" bleeder notch. Outfall structure is a 20.0' weir with a 3" bleeder slot. Discharge is to the Estero River. Allowable discharge is 10 cfs.

SFWMD Permit No. 36-00252-S is issued to Wildcat Run, Phase II, for a modification to an existing surface water management permit located in Lee County S30,31/T46S/R26E. The modification includes construction and operation of a 9.6 acre Phase II residential tract within the 481 acre Wildcat Run development. The modification also updates the conceptual approval to reflect the addition of 2,413 LF of bulkhead on the project lakes and the construction and operation of the water management system servicing 6.4 acres of sewage treatment plant discharging to wetlands south of the project. Drainage facilities include a pump system when system #4 reaches 17.0 feet in elevation. Receiving waterbody is wetlands to the south of the project.

SFWMD Permit No. 36-00260-S is issued to the Green Meadows Mine for a surface water management system located in Lee County S2,3/T46S/R26E. The system serves a 405 acre mining operation. The permit also covers 1,155 acres of seasonal farm land for a total of 1,560 acres. Drainage facilities include continued use of existing dewatering pump system discharging into expanding detention area designed to retain all dewatering discharge and discharge only stormwater flow. The retention area is surrounded by a 3.5' high by 12' wide dike. Stormwater discharged from the retention area is via one outfall structure which consists of one 19" x 30" culvert with a 6.67' weir, and a 3.83" bleeder notch. Stormwater flow routed on-site through existing swales to a discharge point into an unnamed slough.

SFWMD Permit No. 36-00252-S is issued to Wildcat Run for a modification of the surface water management permit for a residential land use in Lee County S30,31/T46S/R26E. This modification is for the construction of a 9.6 acre Phase II residential tract within the 584 acre Wildcat Run

Development. Drainage facilities include inlets, culverts, and overland flow from the site into the master surface water management system for Wildcat Run. This modification also includes an insignificant amount of lake excavation and filling. Receiving waters are wetlands to the south of the project.

SFWMD Permit No. 36-01428-S is issued to Lee County Fill Dirt for a surface water management system in Lee County S19/T45S/R27E. The project is a 54.45 acre mining operation. Drainage facilities include 26.15 acres of existing excavated lake, and a perimeter swale. Total retention is achieved in the on-site lake.

SFWMD Permit No. 36-00681-S is issued to Fort Myer Mine Phase II for a modification to an existing surface water management permit located in Lee County S--/T45,46S/R25,26E. The project is a 10,600 acre limerock mine. This modification is for Phase II B (508.05 acres) with discharge to on-site retention.

SFWMD Permit No. 36-01606-S is issued to Sun State Excavation, Inc. for a surface water management system serving a 596 acre mining operation in Lee County S27,34/T45S/R27E. Project is a limerock mine with total on-site retention. No piping, permanent conveyance system, or control structures are proposed.

SFWMD Permit No. 36-00621-S is issued to Lee County School Board for the Estero High School surface water management system located in Lee County S34/T46S/R25E. Project is a school facility. Drainage facilities include one-2.83' wide by 0.75' high triangular orifice with an invert elevation of 12.5' NGVD and 80 LF of 24" diameter culvert. Discharge is along existing drainage easements to the Estero River. Allowable discharge is 7 cfs.

SFWMD Permit No. 36-00735-S is issued to Weiner Homes for a surface water management system located in Lee County S27,34/T46S/R25E. Project is a 283.0 acre residential land use. Drainage facilities include eleven designated drainage basins with structures, bleeders, and culverts. Stormwater is routed through interconnected ponds, discharging to the Estero River. Allowable discharge is 31 cfs.

SFWMD Permit No. 36-00676-SW is issued to Breckenridge PUD for an irrigation water use permit located in Lee County S29/T46S/R25E. The permit authorizes the continuation of an existing use of groundwater and surface water from the Surficial Aquifer and the project lake system for landscaping irrigation serving 26 acres with an annual allocation of 29.7 million gallons. Wells include four - 1.5 inch x 5 hp x 100 gpm surface water pumps, one - 4 inch x 33 foot x gpm well cased to 13 feet, one - 4 inch x 33 foot x 30 gpm well cased to 10 feet and one existing 6 inch x 45 foot x 38 gpm well cased to 20 feet. Maximum daily withdrawal not to exceed 151,000 gallons.

SFWMD Permit No. 36-00491-S is issued to the Villages of San Carlos for a modification to an existing surface water management permit located in Lee County S10,15,22,23/T46S/R25E. Permit is for the construction and operation of a water management system serving 107 acres of residential and commercial land uses. The system consists of four basins which include a series of swales directing runoff to 1.45 acres of dry detention areas with bottom elevation of 17' NGVD and a key ditch system having a bottom elevation of 16' NGVD. Runoff discharges through a control structure consisting of one 1' high by 0.58' wide inverted triangular orifice with an invert at elevation 16' NGVD and 35 LF of 1.25' diameter culvert to a conveyance canal running parallel to I-75. Total project area is 460 acres. Receiving waterbody is the Estero River. Allowable discharge is 2 cfs.

SFWMD Permit No. 36-01194-S is issued to Spring Creek Estates, a 71.7 acre residential land use located in Lee County S17,18/T47S/R25E. This surface water management system consists of four basins, each with a control structure and culvert discharging via wetlands, canals, and lake into Estero Bay.

4.4.5.2 Agricultural Management Practices

Approximately 24% (10,791 acres) of the Estero River Basin includes agricultural land uses (Table 4-15), predominantly crop and pasturelands. Permitted surface water management systems and groundwater withdrawals in the basin, based on permit files from the SWFWMD, are listed in Table 4-18 and described below. Agricultural land use estimates for major irrigated crops for 1990 in the basin are listed in Table 4-17.

Table 4-17. 1990 estimated irrigated crop acreages in the Estero River Basin.	
CROP	ACREAGE
Improved Pasture	6,114
Row Crops	1,907

Table 4-18. Permitted surface water discharges (cfs) and groundwater withdrawals (MG) for the Estero River Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED ANNUAL DISCHARGE/WITHDRAWAL
Withdrawals			
<i>36-00234-W</i>	300	Shallow	19.4 MG
<i>36-00283-S</i>	276	Tamiami Aquifer	1.54 MG
<i>36-00286-S</i>	20	Sandstone Aquifer	69.57 MG

Table 4-18. Permitted surface water discharges (cfs) and groundwater withdrawals (MG) for the Estero River Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED ANNUAL DISCHARGE/WITHDRAWAL
Surface Water Discharge			
36-00288-S	3,005	-	180 cfs
36-00102-S	1,145	-	50 cfs

SFWMD Permit No. 36-00288-S is issued to Sweetwater Ranch for a modification to a surface water management system located in Lee County S2,3,4,9,10,11/T47S/R25E. Project is a 3,005 acre agricultural development. Drainage facilities include eight 36" diameter culverts each with a 36" wide weir. This modification changes the previously permitted eight culverts to four 48" culverts. Receiving waterbody is the South Branch of the Estero River, San Carlos Estates Drainage District Canal and the borrow canal along Seaboard Coast Line Railroad Tract. Allowable discharge is 180 cfs.

SFWMD Permit No. 36-00286-S, issued to Pottinger's Nursery Inc. for modification of an existing water use located in Lee County S09/T46S/R25E. The modification extends the duration of the permit. Permitted facilities remain unchanged. Original permit was for the continuation of an existing groundwater withdrawal from the sandstone aquifer for agricultural irrigation serving 20 acres with an annual withdraw of 69.57 MG.

SFWMD Permit No. 36-00283-S, issued to R&B Farms for the continuation of an existing use of groundwater from the lower Tamiami Aquifer for agricultural irrigation serving 276 acres with an annual allocation of 228.1 million gallons. The project is located in Lee County S11,14/T46S/R25E. Withdrawal facilities include three 8" x 85' x 600 gpm existing wells cased unknown feet. Daily maximum withdrawal shall not exceed 1.54 mg.

SFWMD Permit No. 36-00102-S, issued to Waldee Brothers Farm for a modification to the existing surface water management system located in Lee County S--/T46S/R26E. This permit modification is for the operation of a surface water management system serving a 1,145 acre agricultural land use by 5- 10,000 gpm pumps discharging into adjacent lowlands. Allowable discharge is 50 cfs. Original permit includes use of groundwater from 14 wells pumped at a capacity of 25,600 gpm from the shallow aquifer.

SFWMD Permit No. 36-00234-W, issued to Douglas Biggar for an irrigation water use system in Lee County S13,14,23/T45S/R26E. This permit authorizes the use of groundwater from the shallow aquifer for agricultural irrigation serving 300 acres with a monthly withdrawal of 233 million gallons. Withdrawal facilities are from four wells including: one 8"x 200' well, one 8" x 85' well. One 6" x 30' well, and one 6" x 17' well. Withdrawal is from the shallow water aquifer at a total capacity of 6,652 gpm. Seven additional wells are referenced as not being in use.

4.5 Imperial River

The Imperial River Basin includes 53,664 acres in the Estero Bay Watershed and covers 27% of the watershed. The basin is the largest in Lee County and is located south of the Spring Creek basin and extends northeast beyond the coastal basins to S.R. 82. Major developments in the basin are located west of I-75 and include Bonita Beach, Bonita Bay, and Bonita Springs.

The Imperial River is the southernmost discharge point to Estero Bay in Lee County. The southwestern portion of Lee County has experienced some of the most severe flooding in recent years, most notably during the summer of 1995 flooding in the Bonita Springs area. Leitner River and Kehl Canal are tributaries to the Imperial River, which discharges into Fish Trap Bay and is a major tributary to the southernmost portion of the Estero Bay Aquatic Preserve.

The Corkscrew Regional Ecosystem Watershed Trust (CREW) is included in the Imperial River Watershed. Established at the turn of the 1990s, the goal of the Trust is acquisition of the wetland areas in the upper reaches of the Imperial River Basin, Flint Pen Strand, as well as similar properties that connect to Corkscrew Swamp. Since its founding, the Trust has acquired over 14,000 acres, and has expanded its interests to include wetland upper reaches of the lower Estero Bay Watershed. It provides trails and interpretive sites on the upland portions of its holdings.

4.5.1 Topography

Elevations in the Imperial River Basin generally increase from sea level at the coast to the 30 foot contour along S.R. 82 at the northeast boundary of the basin. The highest elevations are associated with the Immokalee Rise. Lower elevations are associated with the Imperial River and coastal area. A 10 foot contour line approximates the location of S.R. 41 in the basin.

4.5.2 Soils

Soils in the Imperial River Basin, like those of other interior basins, are more variable than those described for the lower-lying and coastal basins. Flatwoods and slough soils dominate the upper basin where agriculture is the dominant land use and marshes occur in undeveloped areas. These soils are primarily Oldsmar-Malabar-Immokalee to the north and Immokalee-Myakka along the coast. Soils in these series are nearly level, poorly drained, deep sandy soils. Other flatwoods soils which surround the sloughs and swamps include Immokalee-Pompano soils to the east, and Hallandale-Boca soils to the west of I-75.

The sloughs and swamps themselves occur over Isles-Boca-Pompano soils and are an extension of the sloughs and swamps associated with Corkscrew Swamp to the south and east. The water table in these depressional soils is above the surface for 3-6 months of the year. In general, these soils are

composed of the coastal Holocene sediments and undifferentiated shell beds in the interior portion of the Estero Bay Watershed. Anthropogenically altered or arent soils (e.g., dredge and fill, shell mounds, and landfills) also occur in the basin.

About 3% of the soils in the Imperial River Basin is classified as less well-drained or well-drained (HSG designations C and A, respectively), while 96% is classified as D (poorly drained) (Plate 4-9 and Table 4-19). The drainage characteristics and associated vegetation of the soils within the Imperial River Basin were described previously in Section 2.4. Soils others than poorly drained are located west of I-75 in the basin and are associated with extensive development. This section presents the detailed USDA/SCS soil information as compiled in a GIS database for the Estero Bay Watershed. This information has been combined with updated 1995 land use data in order to model surface water hydrology for the basin.

Nearly all the individual soils series within the 53,254 acres of mapped soils in the basin have been assigned an HSG value of D (Plate 4-9) and total 51,358 acres. HSG-designated D soils have very slow infiltration rates when thoroughly wetted, thus, the runoff within the basin is expected to be high. These soils are primarily clay with a high permanent water table or shallow soils over nearly impervious materials, such as a clay pan or clay layer.

The small area of HSG-designated A soils is located in the southern most portion of the basin just west of I-75 and is predominantly Orsino soils. These nearly level to gently sloping soils occur on narrow upland ridges and are generally associated with Immokalee and Myakka soils. The water table in Orsino soils is at a depth of 40 to 60 inches for about 3 months of the year and at a depth of 60 to 80 inches for about 9 months of the year. The B and C soils are also associated with development in the south basin.

Table 4-19. Hydrologic soil groups in the Imperial River Basin.		
HYDROLOGIC SOIL GROUP	AREA (acres)	PERCENT COVER
A	1,091	2%
B	171	<1%
C	634	1%
D	51,358	96%
TOTAL	53,254	100%

4.5.3 Existing Land Use

Existing land use acreages for the Imperial River Basin are presented in Table 4-20. A map of existing land use for the basin is presented in Plate 4-10. Land use classes listed in both the table and

map are grouped as developed (urban and agriculture), undeveloped (natural land cover), and water. Land use in the Imperial River Basin includes almost 40% developed lands, 20% (10,870 acres) of which is in crop and pasture lands. Agricultural lands dominate the landscape in the north and northwest portions of the basin.

Residential areas comprise 9% of the overall land use in the basin, with predominantly medium density (3,165 acres) associated with the Bonita Springs communities in the southern reaches of the basin west of I-75. Low and high density residential and mobile homes combined make up only 3% of the land use in the basin.

Recreation land use makes up 4% (2,055 acres) of the basin land use. Recreation land use in the basin is associated with golf and country clubs, similar to those in other coastal areas of the Estero Bay Watershed.

Commercial/industrial and transportation land uses combined constitute only 2% (839 acres) of the Imperial River Basin. Transportation and utilities are primarily associated with I-75, S.R. 41, and several other roadways, mostly west of I-75.

Sixty percent (32,365 acres) of the Imperial River Basin is classified as undeveloped, most of which is freshwater wetlands. Wetland coniferous forests (cypress swamps and sloughs) make up 20% (10,926 acres) of the land cover in the basin, and another 20% includes marshes and bottomland hardwoods. Marshes in the basin are associated with sloughs and freshwater wetlands and are generally sawgrass marshes. Small areas of saltmarsh occur at the mouth of the Imperial River, although mangrove swamps are the dominant vegetation there.

Natural communities in the Imperial River Basin include pine flatwoods, cabbage palm hammock, sand pine scrub and oak hammock. Freshwater wetlands include wetland hardwoods and marshes. Tidal wetlands in the basin are dominated by mangroves and saltmarshes. Exotics continue to pose a threat in upland and wetland communities (State of the Bay Report, 1998).

Undeveloped uplands cover approximately 20% (10,889 acres) of the Imperial River Basin and are predominantly coniferous forests (pinelands), which make up 17% (9,014 acres) of the basin located along the periphery of sloughs and swamp. Vegetation communities range from sawgrass marshes in the upper reaches of the basin to cypress sloughs interspersed with freshwater prairies and marshes. The deeper flowways transition to cypress strands with mixed pine and cypress forest.

Upland hardwoods, rangelands, and brushland comprise only about 3% of the basin and are located in the southwest corner of the basin in association with developed areas. Upland communities include pine and saw palmetto islands along with cabbage palm hammocks and other mixed upland hardwood communities.

Water occurs primarily as reservoirs (392 acres) resulting from dredge activities and is frequently located along with golf and country club communities. Streams and waterways, lakes, and sloughs make up less than 1% of the total basin area. These areas result in the discrepancy in total acres between soils and land use as a result of the area being designated as water in the soils map and disturbed land on the land use map.

Table 4-20. Land use and land cover in the Imperial River Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Residential		
Residential Low Density	656	1%
Residential Medium Density	3,165	6%
Residential High Density	343	<1%
Residential - Mobile Homes	650	1%
Subtotal	3,080	9%
Commercial/Industrial		
Commercial and Services	261	<1%
Industrial	28	<1%
Institutional	78	<1%
Subtotal	367	<1%
Barren Land		
Extractive	9	<1%
Disturbed Lands	1,208	3%
Recreation and Open Land		
Recreational	500	1%
Open Land	1,477	3%
Subtotal	2,077	4%
Transportation and Utilities		
Transportation	348	1%
Communications	11	<1%
Utilities	191	<1%
Subtotal	550	1%
Agriculture		
Cropland and Pastureland	10,870	20%
Tree Crops	413	1%
Nurseries and Vineyards	108	<1%
Specialty Farms	36	<1%

Table 4-20. Land use and land cover in the Imperial River Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Tree Plantations	17	<1%
Subtotal	11,444	21%
Disturbed Land		
Beaches Other Than Swimming Beaches	35	<1%
Sand Other Than Beaches	10	<1%
Disturbed Lands	1,464	3%
Subtotal	1,509	3%
TOTAL DEVELOPED LANDS	20,661	39%
Shrubland and Brushlands	242	<1%
Upland Forested		
Upland Coniferous Forests	9,014	17%
Upland Hardwood Forests	1,264	2%
Subtotal	10,278	19%
Wetlands		
Wetland Coniferous Forests	10,926	20%
Wetland Hardwood Forests	1,561	3%
Vegetated Non-Forested Wetlands	5,067	9%
Wetland Forested Mixed	3,922	7%
Subtotal	21,476	40%
TOTAL UNDEVELOPED LANDS	32,365	60%
Water		
Streams and Waterways	88	<1%
Lakes	44	<1%
Bays and Estuaries	8	<1%
Reservoirs	392	1%
Slough Waters	106	<1%
Subtotal	638	1%
TOTAL	53,664	100%

4.5.4 Geologic and Drainage Features

The Imperial River Basin is characterized by surface and subsurface drainage features that interact with each other. There is a network of canals in the basin which provide stormwater and

groundwater drainage for primarily agricultural areas, which makes up 20% of the basin land use. Approximately 60% of the basin is undeveloped. The existing geologic and drainage systems are discussed in the following sections.

4.5.4.1 Hydrogeology

There are three major aquifer systems underlying the Estero Bay Watershed, including the Imperial River Basin. These are the:

- ! Surficial Aquifer System,
- ! Intermediate Aquifer System, and
- ! Floridan Aquifer System.

The Surficial Aquifer is the uppermost aquifer and includes the water table aquifer, confining beds, and the lower Tamiami aquifer; the water table aquifer and the lower Tamiami Aquifer are the two main water-bearing formations. The water table aquifer is an unconfined aquifer of primarily undifferentiated sands, shell beds, calcareous clays, and some limestone. The semi-confining Tamiami confining zone separates the water table aquifer from the Lower Tamiami Aquifer.

The Surficial Aquifer is the most significant aquifer system since it is the closest to the surface and is at times in direct connection with surface water. The potentiometric surface of this aquifer follows land surface contours and for undrained areas, wet season water levels are seldom less than 3 feet above or below land surface. The water level in the water table aquifer in the Imperial River Basin ranges from 4 feet NGVD in the coastal areas to 28 feet NGVD at the eastern boundary (SFWMD, 1990).

Thickness of the Surficial Aquifer varies between 25 and 50 feet in central Lee County to and thickens toward the southeastern part of Lee County. Movement in the Surficial Aquifer is generally southwest and provides water for baseflow for major streams and rivers in the watershed.

In areas where the underlying Hawthorn confining zone is thin or absent the Surficial Aquifer is in direct hydraulic connection with the Sandstone Aquifer. The upper Hawthorn confining zone separates the Surficial Aquifer from the Sandstone Aquifer in most of Lee County and ranges from 0 to 25 feet below the surface in the central portion of the watershed and the thickness decreases farther south and is absent near Bonita Springs.

The Intermediate Aquifer, also called the Hawthorn Aquifer, lies below the Surficial Aquifer and is comprised of the five major units listed below. The two water producing zones of this system are the Sandstone and Mid-Hawthorn aquifers (SFWMD, 1982).

- ! Upper Hawthorn Confining Zone,

- ! Sandstone Aquifer,
- ! Mid-Hawthorn Confining Zone,
- ! Mid-Hawthorn Aquifer, and
- ! Lower Hawthorn/Tampa Confining Zone.

The Floridan Aquifer underlies all of Florida. The top of the Floridan Aquifer is associated with the lower Hawthorn Formation and the Tampa Formation, the top of which ranges from -350 feet in northwestern Lee County to -700 feet in the southern portion of the county. The potentiometric surface of the Mid-Hawthorne Aquifer ranges from less than 20 feet NGVD at the coast to more than 50 feet NGVD along the eastern boundary of the Imperial River Basin (SFWMD, 1990).

The Sandstone aquifer underlies the upper Hawthorn confining zone throughout nearly the entire watershed. The Sandstone Aquifer ranges from 0 feet NGVD in the coastal portions of the Imperial River Basin to 20 feet NGVD along the eastern boundary. In the northern part of the Estero Bay Watershed, the aquifer surface lies between 25 and 50 feet NGVD, but it dips in a southerly direction to 150 feet below the surface in the southeastern portion of Lee County.

The Tamiami and Hawthorn formations are approximately 40-580 feet in thickness in Lee County. The lower Hawthorn Aquifer lies between 20 and 30 feet NGVD in the Imperial River Basin. These formations occur as limestones and dolomites and serve as reservoirs for the Tamiami and upper Hawthorn aquifers which supply freshwater. The Lower Hawthorn Aquifer water supply is highly saline (SWRPC, 1995).

4.5.4.2 Surface Drainage

The Imperial River Basin is drained by the Imperial River, and other small drainage conveyances, into southern Estero Bay. As sheetflow moves southwest across the basin, it is collected by natural and artificially constructed channels and conveyed into the Imperial River, as well as the Estero River, Halfway Creek, Spring Creek, Cocohatchee River, Corkscrew Canal, and Camp Keais Strand. Historically, the sheetflow distribution across the basin has been relatively even. With the construction of S.R. 41, and more so, the construction of I-75, sheetflow south from Lake Trafford and Corkscrew Swamp was constricted and diverted west to the Imperial River before entering Estero Bay at its southernmost reaches.

Much of the sheetflow of water from northeast to southwest in the basin has been obstructed by a series of elevated grades and dikes in the interstate area between Corkscrew Road on the north and County Road 846 on the south (JEI, 1998) and during high rainfall events much of the flow of water

spills over to the western portion of the basin into the Imperial River rather than flowing southwest to the Cocohatchee River.

As a result, the Imperial River and other tributaries to Estero Bay cannot accommodate the runoff generated from the upstream Corkscrew Swamp area, and low-lying areas in southwest Lee County are inundated by stormwater runoff generated miles away. The cumulative effects of these hydrologic alterations have led to lower dry season water tables, point discharges of runoff rather than sheetflow, and decreases in stage and timing of wetland inundation. For example, the Imperial River Basin may drain only 86 square miles under “average” conditions, while in times of major flood events , such as in 1995, it may drain up to 250 miles (JEI, 1998).

4.5.5 Management Practices

Approximately 18% of the Imperial River Basin is classified as urban land (Table 4-20). The urbanized areas of the basin are dispersed throughout the basin. The discussion of urban management practices is divided into urban water uses and urban water discharges. The water uses and water discharges are listed in the following descriptions.

4.5.5.1 Urban Management Practices

Urban water uses include public water supply, mining facilities, industrial operations, and recreational uses. Table 4-21 lists the surface water discharges permitted in the Imperial River basin and any permitted withdrawals. Accordingly, water management features are summarized below. Information was obtained from SFWMD permit files.

Table 4-21. Surface water discharges (cfs) and groundwater withdrawals permitted in the Imperial River Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED DISCHARGE/ANNUAL ALLOCATION
Surface Water Discharge			
<i>36-00715-S/W</i>	33.8	-	40.4 cfs
<i>36-00464-S</i>	20	-	8 cfs
<i>36-00439-S</i>	53.58	-	8 cfs
<i>36-00353-S</i>	36	-	2 cfs
<i>36-00330-S</i>	20	-	8 cfs
<i>36-00290-S</i>	37.3	-	9 cfs

Table 4-21. Surface water discharges (cfs) and groundwater withdrawals permitted in the Imperial River Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED DISCHARGE/ANNUAL ALLOCATION
<i>36-00164-S</i>	23.4	-	15 cfs
<i>36-00668-S</i>	16.6	-	2 cfs
<i>36-00317-S</i>	59.7	-	10 cfs
<i>36-00203-S</i>	19.3	-	21 cfs
<i>36-00715-W/S</i>	126	-	13 cfs
<i>36-00247-S</i>	11.6	-	13 cfs
<i>36-00718</i>	31.97	-	9 cfs
<i>36-00398-S</i>	19.88	-	16 cfs
<i>36-00418-S</i>	7.43	-	2 cfs
<i>36-00610-S</i>	644.61	-	18.5 cfs
Groundwater Withdrawal			
<i>36-00715-W</i>	96.6	Lower Tamiami Aquifer	97.14 MG

Water use and surface water management permits within the basin have been issued as follows:

SFWMD Permit No. 36-02026-S, issued to Bonita Fairways and Tennis Club for a surface water management system, serves a 36 acre residential land use located in Lee County S27/T47S/R25E. The system includes an 8 acre detention pond with a V-notched control structure at 8.80' NGVD and an invert at elevation 7.0' NGVD. Water will discharge from the weir to an existing ditch which leads to the Imperial River. Allowable discharge is 2 cfs.

SFWMD Permit No. 36-01822-S is issued to the Lee County Board of County Commissioners for the construction and operation of a temporary weir structure serving mixed lands discharging into the Imperial River via Kehl Canal. The project is located in Lee County S32/T47S/R25E. Project includes a broad crested weir with a total length of 66' with a crest at elevation 10.0' NGVD and an operable flashboard riser. The weir was permitted in December 1990 as a temporary structure unit until the Lee County Surface Water Management Plan is completed. The weir is constructed of compacted fill with grout-filled fabric revetment.

SFWMD Permit No. 36-01809-S/W, issued to Crisafulli Service Center for a surface water management system, serves 5.61 acres of commercial lands in Lee County S6/T48S/R26E. Drainage facilities consist of a one acre pond with a discharge structure, one 3.0" diameter bleeder orifice with an invert at elevation 11.0' NGVD discharging to 50 LF of rip-rap spreader swales. Discharge is to the Imperial River via adjacent wetlands. The permit also gives conceptual approval for an additional 4.54 acres of wastewater treatment plant to be developed at a later date. Additional commercial phases are referenced.

SFWMD Permit No. 36-01472-S is issued to Worthington Developments Inc. for a modification to an existing surface water management system located in Lee County S5/T48S/R26E. The system is for a 327.68 acre residential and recreation land use consisting of basins designated as II-X, XI & XII. This modification increases impervious surfaces by 0.91 acres. The master system, approved previously, includes 11 lakes, inlets, culverts, structures, and swales. Discharge from the system is to the Imperial River via the Kiel Canal and roadside ditches.

SFWMD Permit No. 36-00715-S/W, issued to Brentwood Estates for surface and groundwater use, serves 33.8 acres located in Lee County S6/T48S/R26E. The system is for irrigation of 33.8 acres of golf/landscape with an annual allocation of 39.51 million gallons. Groundwater withdrawal from the lower Tamiami Aquifer is from one 8" x 100' x 650 gpm well. This permit also authorizes a surface water management system for 63.0 acres of residential and recreational lands. Drainage facilities include wet detention ponds, with one 3.48' wide, 82 degree V-notched weir with an invert elevation at 13.0' NGVD and 24 LF of 30" culvert. Receiving waterbody is Oak Creek via existing ditches. The master system includes 5 phases serving 126.0 acres with an allowable discharge of 40.4 cfs.

SFWMD Permit No. 36-00464-S is issued to Imperial Oaks for a surface water management system serving a 20 acre single family residential development in Lee County S36/T47S/R25E. Drainage facilities include a system of swales, catch basins, and storm drains conveying runoff to a 1.92 acre lake. Discharge from the lake is via 425 LF of 9" x 30" culvert through an outfall structure consisting of one 0.5' wide weir with a crest elevation of 12.0' NGVD, and one 0.5' wide 28 degree V-notch bleeder with invert elevation of 11.0' NGVD. Discharge is into the Imperial River via the Imperial Street roadside swale. Allowable discharge is 8 cfs.

SFWMD Permit No. 36-00439-S, issued to Lakes of San Soui Subdivision for a surface water management system, serves 53.58 acres of residential lands in Lee County S31/T47S/R26E. Drainage facilities include a storm sewer and swale system, a 7 acre on-site lake, one 2.0' wide weir and 150 LF of 19" x 30" culvert discharging via an existing I-75 roadside swale into the Imperial River. Allowable discharge is 8 cfs.

SFWMD Permit No. 36-00418-S, issued to Spring Lakes, Phase II for a modification to an existing surface water management system, serves a 74.8 acre residential land use in Lee County

S25/T47S/R25E. Phase II is for 25.6 acres of the 74.8 acre master project. Drainage facilities addressed in this modification include a reduction in the on-site lake size from 8.9 acres to 8.5 acres. This phase is incorporated into the existing master surface water management system which includes inlets, swales, on-site lakes, and 270 LF of 19" x 30" culvert, one 6" diameter circular orifice with invert elevation of 12.0' NGVD, 920 LF of outfall swale discharging to 910 LF of spreader swale.

SFWMD Permit No. 36-00378-S, issued to Hacienda Villages, Phase III for a surface water management system serving a 37.56 acre residential land use in Lee County S34/T47S/R25E. Drainage facilities include on-site lakes and dry detention areas providing 18.4 acre feet of detention, and twin structures with overflow to 60 LF of 18" culvert. Outfall proceeds north under Pennsylvania Avenue by an existing stormwater sewer line to a Lee County drainage canal which outfalls to the Imperial River.

SFWMD Permit No. 36-00353-S is issued to Imperial Harbor Unit 7 for a surface water management system serving a 36 acre residential land use in Lee County S27/T47S/R25E. Drainage facilities include a system of catch basins and grassy swales which direct runoff to an 8 acre wet detention pond. Water discharges from the pond via one 21 degree V-notch weir with a crest at elevation 8.80' NGVD and an invert elevation of 7.00' NGVD. Water will be discharged to an existing ditch south to the Imperial River. Allowable discharge is 2 cfs.

SFWMD Permit No. 36-00330-S, issued to Aroyal Pines for a modification to an existing surface water management system serves a 20 acre residential land use in Lee County S36/T47S/R25E. This modification removes the existing permitted outfall structure, expands the lake to 3.6 acres, and constructs a new control structure with an invert elevation of 11.0' NGVD. The discharge is to a perimeter spreader swale which discharges to the surrounding property by spreader swale, then by sheetflow to eventual outfall to the Imperial River. Allowable discharge is 8 cfs.

SFWMD Permit No. 36-00290-S is issued to Pine Haven Condominium for a surface water management system serving a 37.3 acre residential land use in Lee County S2/T48S/R25E. Drainage facilities include inlets, catch basins, and culverts, on-site retention pond, and a 2.0' wide discharge structure with invert elevation at 8.0' NGVD. Outfall is to Oak Creek via an existing ditch. Allowable discharge is 9.0 cfs.

SFWMD Permit No. 36-00271-S is issued for Bonita Grand Drive, a 2 mile road extension located in Lee County S31,32/T47S/R26E. This roadway has 20' of paved travel lanes with 14' swales constructed on each side in the 60' right of way. The roadway is proposed to span the Kehl Canal with a bridge designed to pass the 25 year discharge of 2,670 cfs. There are 19 perpendicular equalizing crossdrains. Discharge is to the Kehl Canal and the Imperial River. No allowable discharge provided.

SFWMD Permit No. 36-00164-S issued for Rosemary Lake, a 23.4 acre residential development located in Lee County S26/T47S/R25E. This surface water management permit is for the construction and operation of a drainage system consisting of a system of grassy swales, inlets, culverts, on-site lake and outfall structure with one 30" culvert, weir and one 1" bleeder slot discharging to an unnamed creek which flows to the Imperial River. Allowable discharge is 15 cfs.

SFWMD Permit No. 36-00131-S is issued for Sandy Hollow, a 34 acre residential land use in Lee County S23,26/T47S/R25E. This permit modification increases impervious area by 0.6 acres. A discharge of 9 cfs was previously permitted and no increase in discharge was approved by this modification. Outfall is to the U.S. 41 roadside ditch, to Leitner Creek and the San Carlos Drainage ditch.

SFWMD Permit No. 36-00666-S is issued for the Zion Lutheran Church in Lee County S34/T45S/R24E. Permit is for a surface water management system consisting of one 0.5' wide weir with a crest elevation of 5.5' NGVD, with one 0.25' diameter circular orifice with invert at 4.25' NGVD, and 23 LF of 14" culvert. Discharge is to the IDD Canal H-1.

SFWMD Permit No. 36-00668-S is issued for Summerlin Trace, a 16.6 acre residential land use in Lee County, S27/T45S/R24E. This permit is for a surface water management permit consisting of an on-site lake with a discharge via a structure with one 9.5" diameter orifice and 152 LF of 30" diameter culvert to the drainage easement along Summerlin Road. Allowable discharge is 2 cfs.

SFWMD Permit No. 36-00317-S issued to Springs Plaza for a surface water management system, serves 59.7 acres of residential and commercial land uses. The system consists of an on-site detention lake, swales inlets, culverts and control structure discharging to a spreader swale and to natural sheetflow. Allowable discharge is 10 cfs. Project is within the Imperial River basin.

SFWMD Permit No. 36-00203-S is issued to Sunshine Suprex for a 19.3 acre commercial land use located in Lee County S34/T47S/R25E. This surface water management system consists of two basins with a system of inlets, culverts, dry retention areas and exfiltration trench discharging via one - 2.25 sf rectangular inlet to 75 LF of 30" x 19" culvert to an off-site borrow pit and through the Branch Creek to the Imperial River. Allowable discharge is 21 cfs.

SFWMD Permit No. 36-00715-W/S is issued to Hunters Ridge, a residential land use with golf course and landscaped area in Lee County S6/T48S/R26E. This conceptual permit is for 126 acres, and is a construction permit for Phase 1 of the project. Each additional phase will require construction permits. Groundwater flow is from the lower Tamiami aquifer via a 8" x 100' x 650 gpm well. Maximum allowable annual withdrawal is 39.51 MG. The surface water management system includes a system of swales, inlets, and culverts directing water to 6.99 acres of interconnected lakes and 24.02 acres of on-site cypress wetlands. Allowable discharge is 13 cfs. Receiving waterbody is oak Creek via existing ditches. Additional permits to follow.

SFWMD Permit No. 36-00715-W is issued to Hunters Ridge a 96.6 acres golf course and landscaped area in Lee County S6/T48S/R26E. This water use permit allows withdrawal from the groundwater for irrigation of 83.1 acres of residential and golf course via two - 8" x 100' x 650 gpm wells cased to 60'. Maximum annual withdrawal is 97.14 mg.

SFWMD Permit No. 36-00715-W/S issued to Hunters Ridge, a 96.6 acres golf course and landscaped area in Lee County S6/T48S/R26E. This is a modification to an existing water use and surface water management system to continue existing groundwater and surface water use from the lower Tamiami Aquifer and on-site lakes to irrigate the golf course and landscaped areas. Total annual allocation is 97 million gallons. Groundwater withdrawal is from two 8" x 80' x 600 gpm wells cased to 70 feet. Surface water withdrawals are from on-site lake via one - 4" x 22.1 hp x 225 gpm pump and two - 6" x 46 hp x 500 gpm pumps. This permit modifies the surface water management system by providing additional storage for Phase 5 of the development. The lakes and wetlands are connected to the existing water management system. Runoff is routed through the existing weir. Outfall is to the roadside ditch on I-75 then to Oak Creek with eventual outfall to the Imperial River. Design discharge is 12.22 cfs.

SFWMD Permit No. 36-00715-W/S is issued to Hunters Ridge, a 96.6 acres golf course and landscaped area in Lee County S6/T48S/R26E. This surface water management permit modification is for 7.9 acres of Phase 5B. This modification includes more lake area and less building/paving area than previously permitted. No changes in discharge location or volume.

SFWMD Permit No. 36-00715-W/S is issued to Hunters Ridge, a 96.6 acres golf course and landscaped area in Lee County S6/T48S/R26E. This permit modification is for the replacement of a retaining wall on Lake 18 with rip-rap and enlargement of the littoral zone along the lake. These activities are in compliance with previous permits.

SFWMD Permit No. 36-00247-S is issued to Edenbridge Gardens, a 11.6 acre residential land use in Lee County S34/T47S/R25E. This surface water management permit is for 11.6 acres of residential land use consisting of swales, inlets and culverts which discharge into an on-site lake. The lake discharges into the Imperial River via a 3.8' weir. Allowable discharge is 13 cfs.

SFWMD Permit No. 36-00236-S is issued for Leitner Manor, a 93.7 acre residential land use located in Lee County S25/T47S/R25E. This is a modification to an existing permit to relocate project ditches and change bleeder to one 2' V-notch bleeder with one 2' wide weir discharging into Leitner Creek.

SFWMD Permit No. 36-00236-S is issued for Southern Pines, a 93.7 acre residential land use located in Lee County S25/T47S/R25E. This modification is to relocate the Southern pines discharge structure to facilitate discharge to the new outfall ditch. This modification redirects the primary

discharge to the Rosemary Canal but retains a hydraulic connection with the current outfall, Leitner Creek.

SFWMD Permit No. 36-00754-S is issued for WCVU Transmitter Tower in Lee County S33/T47S/R26E. This is a modification of a previously approved surface water management permit for a 74.8 acre site for the construction of a limerock access road, a building and radio transmission tower. Revisions include changes in the crown elevation of the access road, revised design of road to allow for emergency vehicle access, plus changes in the crest elevations of the surface water management discharge structure. Discharge is into the Kehl Canal. No discharge volume provided.

SFWMD Permit No. 36-00718-S is issued for the Center of Bonita Springs in Lee County S33/T47S/R25E. This surface water management permit is for a 31.97 acre commercial land use consisting of a system of catch basins routing water to a dry detention area and to a lake. Discharge is through a 2' wide weir with a crest elevation of 10.65' NGVD, one - 0.24' wide by 0.7' high inverted triangular orifice with an invert elevation of 7.5' NGVD, and 100 LF of 24" diameter RCP culvert into a borrow pit on the eastern side of U.S. 41. Ultimate outfall is to the Imperial River via ditches and overland sheetflow. Allowable discharge is 9 cfs.

SFWMD Permit No. 36-00314-S is issued for Spanish Lakes, a 30.5 acre residential land use in Lee County S25/T47S/R25E. This surface water management system includes dry on-site retention, with a discharge by sheetflow to a perimeter swale which routes runoff to 1,340 LF of spreader swale. Discharge is to Leitner Creek via sheetflow. No allowable discharge volume.

SFWMD Permit No. 36-00398-S issued for Imperial Pines Subdivision, a 19.88 acre residential land use in Lee County S36/T47S/R25E. This surface water management system is a shared system with Aroyal Pines subdivision, expanding the on-site pond to 3.6 acres. The outfall structure discharges to a perimeter swale which overflows onto surrounding property by sheetflow in a manner comparable to pre-development flow patterns. Flow is eventually into the Imperial River. Allowable discharge is 16 cfs.

SFWMD Permit No. 36-00418-S is issued for Spring Lake, Phase II, a 74.8 acre residential land use in Lee County S25/T47S/R25E. This is a modification to an existing surface water management permit to increase the water management area to 10.24 acres, decrease the number of lots by 3 and decrease the amount of impervious surface by 0.2 acres. Discharge is via spreader swales to Leitner Creek.

SFWMD Permit No. 36-00418-S is issued for The Citadel, a 7.43 acre commercial property located in Lee County S34/T47S/R25E. This surface water management system consists of catch basins, culverts, and swales directing runoff to 0.62 acres of dry retention. Outfall is by a structure consisting of one 6" diameter orifice with an invert at elevation 10.0' NGVD. Discharge is to Imperial River via County maintained swale. Allowable discharge is 2 cfs.

SFWMD Permit No. 36-00531-S is issued for Bonita 75, a multi-family residential project located in Lee County S6/T48S/R26E. This surface water management system consists of a 1.1 acre lake, perimeter swales with a discharge to 560 LF of spreader swales to sheetflow across adjacent property. Ultimate outfall is to the Imperial River. No discharge volume provided.

SFWMD Permit No. 36-00593-S is issued for the 60 acre Crisafulli Excavation located in Lee County S30/T47S/R26E. This surface water management system is for a 36 acre mining operation. The system consists of a series of berms, swales and on-site excavation pond, which provides for on-site retention. The receiving waterbody is the Imperial River. No discharge volume on this totally retained surface water system.

SFWMD Permit No. 36-00610-S is issued for Saddlebrook Trails, a 644.61 acre residential land use in Lee County S21,28,33/T46S/R26E. This surface water management system consists of 446.06 acres of wetlands and 198.55 acres of uplands of which 256.8 acres are preserved, and 122.0 acres of interconnected cypress heads and sloughs which will be preserved and used as water retention areas. Approximately 66.6 acres of wetlands are impacted by development. Mitigation is required for the impacted wetlands. Discharge will flow from a detention area into a control structure and then into a spreader swale. Allowable discharge is 18.5 cfs. Ultimate discharge is to the Imperial River.

SFWMD Permit No. 36-02044-S is issued to the Lee County Board of County Commissioners for the Imperial River Boat Ramp located in Lee County S33/T47S/R25E. This surface water management system is for an 8.5 acre recreation land use that discharges to an existing on-site ditch and on-site wetland and into the Imperial River. Drainage facilities include two - 1.5' wide weir structures each with a 0.25' diameter circular orifice set at control elevation 3.0' NGVD. Each weir structure has a crest elevation of 4.6' NGVD.

SFWMD Permit No. 36-00067-S is issued to the Spanish Wells County Club for a 463.05 acre residential land use in Lee County S2,3/T48S/R25E. This permit contains a number of modifications to the master stormwater system that is generally described as consisting of an on-site retention lake system (13 lakes) that will discharge through one outfall structure into a peripheral ditch that sheetflows south and west.

SFWMD Permit No. 36-00213-S is issued to The Cypress for a 5 acre residential land use in Lee County S27/T45S/R24E, east of Winkler Road. This surface water management system consists of swales, on-site lake, a weir with one - 2.5" diameter bleeder and three 3.0" diameter openings discharging via a county roadside ditch into Iona Drainage District Canal.

4.5.5.2 Agricultural Management Practices

Approximately 19% of the Imperial River Basin includes agricultural land uses (Table 4-20). Agricultural uses include crop and pasturelands and nurseries. Agricultural land use estimates for major irrigated crops for 1990 in the basin are listed in Table 4-22. Permitted withdrawals for agricultural purposes are listed below Table 4-23. Permit information from the SFWMD permit files for these activities are also summarized below.

Table 4-22. 1990 estimated irrigated crop acreages in the Imperial River Basin.	
CROP	ACREAGE
Improved Pasture	3,923
Row Crops	5,799

Table 4-23. Permitted surface water discharges (cfs) and groundwater withdrawals (MG) for the Imperial River Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED ANNUAL DISCHARGE/WITHDRAWAL
Surface Water Discharges			
36-00627-S	150	-	6 cfs
36-00218-S/W	640	-	40 cfs
36-00082-S/W	70	-	4.65 cfs
36-00103-S/W	640	-	40.4 cfs
36-00061-S/W	618	-	40.4 cfs
Withdrawals			
36-00311-S/W	50	Tamiami Aquifer	362.4 MG
36-00093-S/W	395	Water table aquifer	296.3 MG
36-00062-S/W	487	Water table aquifer	930 MG
36-00218-S/W	640	Shallow Water Aquifer	1404 MG
36-00625-S/W	200	Lower Tamiami Aquifer	123 MG
36-02094-S/W	90.6	Sandstone Aquifer	103.7 MG

SFWMD Permit No. 36-00313-S/W, issued to Bigham Farms for a combined surface water management system and water use system, serves a 75 acre agricultural land use in Lee County S29/T47S/R26E. Drainage facilities include one 5000 gpm and one 7500 gpm pump discharging into Cypress Slough via adjacent pine and palmetto woods. The water use system allows use of groundwater from the shallow aquifer from two 8" wells pumped at total capacity of 1350 gpm for agricultural irrigation serving the 75 acre farm.

SFWMD Permit No. 36-00311-S/W, issued to D&D Farms for a combined surface water management system and water use system, serves a 50 acre agricultural land use in Lee County S27/T47S/R25E. The surface water management system includes one 36" culvert discharging into the Imperial River via an unnamed canal. The water use system includes two 6" wells into the Tamiami Aquifer each with a 350 gpm capacity. Permitted monthly withdrawal is at 30.2 MG.

SFWMD Permit No. 36-00093-S/W issued to Trost International Ltd. For a 325 acre agricultural land use located in Lee County S18/T47S/R26E. Permit is for the continued use of groundwater from the water table aquifer for agricultural irrigation. Allowable withdrawal is 296.3 million gallons annually. Wells include 7 - 8" x 25 foot wells cased to unknown depth, and 3-8 inch wells cased to 20 feet. This permit also addresses a surface water management system consisting of a system of grassed swales, perimeter ditches, and 6 - 8,000 gpm pumps discharging to the Imperial River, via Leitner Creek.

SFWMD Permit No. 36-00061-S/W is issued Corkscrew Growers for the continuation of an existing groundwater use serving a 618 acres agricultural land use in Lee County S3/T48S/R26E. This permit allows for the continued withdrawal of 1,009 million gallons annually from the water table aquifer using 11- 8" x 60' x 1500 gpm wells cased to 40 feet. This permit also allows for the continued operation of a surface water management system with an allowable discharge of 40.4 cfs. No stated discharge waterbody.

SFWMD Permit No. 36-00062-S/W is issued Kent Manley for a 487 acre agricultural land use located in Lee County S1/T48S/R26E. Withdrawals are from the water table aquifer through 6 - 8" x 40' x 1,000 gpm wells, and from existing surface water sources using one - 18" x 95 hp x 6000 gpm hydraulic pump and one-20" x 135 hp x 1,000 gpm propeller pump. Permitted withdrawal not to exceed 930 MG annually.

SFWMD Permit No. 36-00103-S/W is issued to G&G Farms for a 640 acre agricultural land use located in Lee County S4,5/T48S/R26E. This permit addresses both the surface water management system and allowable irrigation water use for the project. The surface water system consists of one - 16,000 gpm, one - 10,000 gpm, and one - 6,000 gpm pumps discharging into adjacent lands. Allowable discharge is 40.4 cfs. The water use permits shallow aquifer withdrawals from 11 - 8" wells with 8,500 gpm capacity. Allowable withdrawal is 427 acre feet.

SFWMD Permit No. 36-00082-S/W issued to Hawkins Flower Farm, a 70 acre agricultural land use located in Lee County S8/T45S/R26E. This permit approves both a water use and surface water management system for the project. Water uses allows for shallow water aquifer withdrawal from one - 6" x 35' well pumped at 645 gpm, and surface water withdrawal from a ditch via two - 20" pumps 10,000 gpm each. Allowable allocation is 46.7 acre feet. The surface water management system consists of the two 20" pumps discharging into the South Coastal Watershed. Allowable discharge rate is 4.65 cfs.

SFWMD Permit No. 36-00221-S/W is issued to MWG Farms, a 52 acre agricultural land use located in Lee County S30/T47S/R26E. The permit is for a combined surface water management system and water use. Water withdrawal is from groundwater via one - 8" well pumped at 650 gpm from the shallow aquifer. The surface water management system consist of one - 7,500 gpm discharge pump discharging indirectly into the Imperial River.

SFWMD Permit No. 36-00218-S/W is issued to M&M Farms for a 640 acre agricultural land use located in Lee County S26/T46S/R26E. This is a combined surface water management and water use permit. The surface water system consist of one - 3,000, two - 10,000, and two - 16,000 gpm discharge pumps with a discharge to Corkscrew Swamp. Allowable discharge is 40 cfs. The water use system withdraws groundwater from the shallow water aquifer via four - 8" wells pumped at 1,000 gpm each. Permitted monthly withdrawal is 117 mg.

SFWMD Permit No. 36-00627-S is issued to R.S. & Sons Farm for a 150 acre agricultural land use in Lee County S24/T47S/R26E. This is a surface water management system consisting of canals which route runoff to a 7,300 gpm pump. This pump discharges to a 20.0 acre detention area when water reaches elevation 15.5' NGVD. A series of structures with bleeders control water levels and discharges. The stormwater sheetflows to the Corkscrew Swamp via the 32.2 acre wetland preserve area. Allowable discharge is 6.0 cfs.

SFWMD Permit No. 36-00625-S/W issued for Clidden Farms, a 200 acre agricultural land use in Lee County S24,25,26/T47S/R25E. This is a renewal of an existing permit for a water use and surface water management system. The primary purpose of the permit is to approve the source of water for the irrigation of 200 acres of agricultural lands. The water source is groundwater from the lower Tamiami Aquifer and surface water from an on-site borrow pit. Withdrawal facilities include one- 12 inch x 60 hp surface water pump, one - 8 inch x 52 feet well cased to 30 feet, one - 8 inch x 65 foot well cased to 30 feet, and one - 8 inch x 50 to 60 foot well cased to unknown depth. Maximum annual withdrawal is 123 MGY. Daily maximum withdrawal is 1.31 MGD. The surface water management system consists of a series of dikes swales, inlets, and control structures with a discharge to an existing drainage ditch and into Leitner Creek.

SFWMD Permit No. 36-00612-S/W is issued for the Alico (Section 1) Farm, a 678 acre rock mining operation and agricultural land use in Lee County S1,11,12/T46S/R26E. This combined surface

water management system and water use permit allows for the use of surface water from the on-site pits with a annual withdrawal of 553.7 MG and a maximum daily withdrawal of 5.0 MG. Withdrawal is from one - 20" x 20,000 gpm x 60 hp surface water pump, and one - 10" x 4,000 gpm x 40 hp surface water pump.

SFWMD Permit No. 36-02094-S/W is issued to Sakata Seed America, Inc. for the Florida Research Center, a 90.6 acre agricultural land use located in Lee County S28,33/T45S/R27E. This combined surface water management system and water use permit authorizes the use of groundwater from the Sandstone Aquifer for irrigation of 90.6 acres of agricultural lands with an annual allocation of 103.87 million gallons. The surface water management system consists of a series of swales, ditches, one - 42' wide x 5' high rectangular orifice with invert elevation at 29.9' NGVD discharging to 55 LF of culvert and one drop inlet with crest elevation at 33.9' NGVD. Discharge is to on-site wetlands in the Imperial River Basin.

4.6 Cow Creek

The Cow Creek Basin includes approximately 8,000 acres of the Estero Bay Watershed in coastal Lee County and includes the City of Fort Myers Beach on Estero Island. The Cow Creek Basin makes up the northwestern tip of the larger Estero Bay Watershed and is located just south of the mouth of the Caloosahatchee River. San Carlos Bay lies along the northern coast of the basin and Estero Island parallels the southern coast of the basin. The soils, hydrology, land use, drainage features and land use of the Cow Creek Basin are described in the following sections.

4.6.1 Topography

The Cow Creek basin is relatively flat and ranges in elevation from sea level to about 5 feet above MSL in some small areas in the northern most portions of the basin. Most of the basin is below 5 feet in elevation, including populated areas of Fort Myers Beach. The lowest areas occur along the coast and are associated with bays and Cow Creek.

4.6.2 Soils

General soils types in the Cow Creek Basin are the more coastal Holocene sediments and undifferentiated shell beds in the interior portion of the basin. Anthropogenically altered or arent soils, e.g. dredge and fill, shell mounds, and landfills are also included in the basin. Less than five percent of the soils in the basin are classified as very well-drained, well drained, to less well-drained (HSG designations A, B, and C), while 95% are classified as D (poorly drained) (Table 4-24).

The drainage characteristics and associated vegetation of the soils within the Cow Creek basin were described previously in Section 1.3. This section presents the detailed USDA SCS soil information

as compiled in a GIS database for the Estero Bay Watershed. This information has been combined with updated 1995 land use data in order to model surface water hydrology for the basin.

Soils of the Cow Creek Basin are primarily Peckish-Estero Isles soils characteristic of tidal areas and barrier islands. These soils are nearly level, very poorly drained, and mucky, although some have a sandy, organic-stained subsoil and some have a loamy subsoil. The interior portion of the basin includes Hallandale-Boca and Immokalee-Pompano soils characteristic of flatwoods and sloughs.

The majority of the individual soils series within the 8,000 acre basin have been assigned an HSG value of D (Plate 4-11). These soils total approximately 7,305 acres (Table 4-24). HSG-designated D soils have very slow infiltration rates when thoroughly wetted, thus, the runoff within the basin is expected to be high. These soils are primarily clay with a high permanent water table or shallow soils over nearly impervious materials, such as a clay pan or clay layer.

The remaining soils are designated as Group C and have moderate to high runoff potential. These are the more interior soils with slow infiltration rates when thoroughly wetted, often with a layer of soil that impedes the downward movement of water. These soils make up only 4% (337 acres) of the soil types in the basin.

Table 4-24. Hydrologic soil groups in the Cow Creek Basin.		
HYDROLOGIC SOIL GROUPS	AREA (acres)	PERCENT COVER
A	0	<1%
B	0	<1%
C	337	3%
D	7305	96%
TOTAL	7642	100%

4.6.3 Existing Land Use

Existing land use acreages for the Cow Creek Basin are presented in Table 4-25. A map of existing land use for the basin is presented in Plate 4-12. Land use classes in both the table and map are grouped as developed (urban and agriculture) and undeveloped (natural land cover). Water is included separately.

Twenty-nine percent (2,246 acres) of the basin lands is developed; of these, only 24 acres (less than 1%) are included as agriculture. Residential (1,021 acres) and recreation and open lands (777 acres)

make up 24% of the total basin area. Transportation and utilities and industrial/commercial uses include about 4% of the land use in the basin.

In contrast with developed uses, undeveloped land cover makes up 68% (5,445 acres) of the total basin. Undeveloped land cover is almost completely wetlands (5,319 acres) and the wetlands are predominantly wetland hardwood forests (4,337 acres). Water, including sloughs, reservoirs, lakes, and bays and estuaries, comprise the remaining 294 acres (4%) in the basin.

Table 4-25. Land use and land cover in the Cow Creek Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Residential		
Residential Low Density	57	1%
Residential Medium Density	142	2%
Residential High Density	293	4%
Residential - Mobile Homes	529	7%
Subtotal	1,021	14%
Commercial/Industrial		
Commercial and Services	162	2%
Subtotal	162	2%
Recreation and Open Land		
Recreational	121	2%
Open Land	656	8%
Subtotal	777	10%
Transportation and Utilities		
Transportation	185	1%
Subtotal	185	1%
Agriculture		
Cropland and Pastureland	24	<1%
Subtotal	24	<1%
Disturbed Land		
Beaches Other Than Swimming Beaches	7	<1%
Disturbed Lands	70	1%
Subtotal	77	1%
TOTAL DEVELOPED LANDS	2,246	29%
Upland Forested		
Upland Coniferous Forests	101	1%

Table 4-25. Land use and land cover in the Cow Creek Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Upland Hardwood Forests	25	<1%
Subtotal	126	1%
Wetlands		
Wetland Hardwood Forests	4,337	54%
Vegetated Non-Forested Wetlands	674	8%
Non-Vegetated	308	4%
Subtotal	5,319	67%
TOTAL UNDEVELOPED LANDS	5,445	68%
Water		
Lakes	77	1%
Bays and Estuaries	121	2%
Reservoirs	89	1%
Slough Waters	7	<1%
Subtotal	294	4%
TOTAL	7,985	100%

4.6.4 Geologic and Drainage Features

The Cow Creek Basin is characterized by surface and subsurface drainage features that interact with each other. There is a network of canals in the basin which provide stormwater and groundwater drainage for residential areas, although nearly 70% of the basin is made up of undeveloped wetlands. The existing geologic and drainage systems are discussed in the following sections.

4.6.4.1 Hydrogeology

There are three major aquifer systems underlying the Estero Bay Watershed, including the Cow Creek Basin. These are the:

- ! Surficial Aquifer System,
- ! Intermediate Aquifer System, and
- ! Floridan Aquifer System.

The Surficial Aquifer is the uppermost aquifer and includes the water table aquifer, confining beds, and the lower Tamiami aquifer; the water table aquifer and the lower Tamiami aquifer are the two main water bearing formations. The water table aquifer is an unconfined aquifer of primarily

undifferentiated sands, shell beds, calcareous clays, and some limestone. The semi-confining Tamiami confining zone separates the water table aquifer from the Lower Tamiami Aquifer.

The Surficial Aquifer is the most significant aquifer system since it is the closest to the surface and is at times in direct connection with surface water. The potentiometric surface of this aquifer follows land surface contours and for undrained areas, wet season water levels are seldom less than 3 feet above or below land surface. The water level in the water table aquifer in the Cow Creek Basin does not exceed 4 feet throughout the basin (SFWMD, 1990).

Thickness of the Surficial Aquifer varies between 25 and 50 feet in central Lee County to and thickens toward the southeastern part of Lee County. Movement in the Surficial Aquifer is generally southwest and provides water for baseflow for major streams and rivers in the basin.

In areas where the underlying Hawthorn confining zone is thin or absent the Surficial Aquifer is in direct hydraulic connection with the Sandstone Aquifer. The upper Hawthorn confining zone separates the Surficial Aquifer from the Sandstone Aquifer in most of Lee County and ranges from 0 to 25 feet below the surface in the central portion of the watershed and the thickness decreases farther south and is absent near Bonita Springs. The Sandstone Aquifer is at less than 5 feet NGVD in the Cow Creek Basin.

The Intermediate Aquifer, also called the Hawthorn Aquifer, lies below the Surficial Aquifer and is comprised of the five major units listed below. The two water producing zones of this system are the Sandstone and Mid-Hawthorn aquifers (SFWMD, 1982).

- ! Upper Hawthorn Confining Zone,
- ! Sandstone Aquifer,
- ! Mid-Hawthorn Confining Zone,
- ! Mid-Hawthorn Aquifer, and
- ! Lower Hawthorn/Tampa Confining Zone.

The Floridan Aquifer underlies all of Florida. The top of the Floridan Aquifer is associated with the lower Hawthorn Formation and the Tampa Formation, the top of which ranges from -350 feet in northwestern Lee County to -700 feet in the southern portion of the county. The potentiometric surface of the Mid-Hawthorne Aquifer ranges from -10 and 10 feet NGVD in the Cow Creek Basin (SFWMD, 1990).

The Sandstone Aquifer underlies the upper Hawthorn confining zone throughout nearly the entire watershed. In the northern part of the Estero Bay Watershed, the aquifer surface lies between 25 and 50 feet NGVD, but it dips in a southerly direction to 150 feet below the surface in the southeastern portion of Lee County.

The Tamiami and Hawthorn formations are approximately 40-580 feet in thickness in Lee County. The lower Hawthorn Aquifer lies between 20 and 30 feet NGVD in the Cow Creek Basin. These formations occur as limestones and dolomites and serve as reservoirs for the Tamiami and upper Hawthorn aquifers which supply freshwater. The Lower Hawthorn Aquifer water supply is highly saline (SWRPC, 1995).

4.6.4.2 Surface Drainage

Surface drainage is dependent on groundwater levels, rainfall, and the drainage network characteristics. Groundwater inflows and rainfall are inputs to the surface water hydrologic system, whereas the drainage network controls the output. The rainfall and drainage network for the Cow Creek Basin are discussed below.

The western portion of the Cow Creek Basin drains into Bunche Beach Road to San Carlos Bay, Pelican Bay, and Hurricane Bay. Pelican Bay and Hurricane Bay receive flows from developed residential canals as well as overland sheetflow. The eastern portion of the basin drains via Cow Creek and an unnamed creek into northern Estero Bay.

4.6.5 Management Practices

The developed portions of the Cow Creek Basin include predominantly residential and recreation and open lands (29%) with less than 1% agriculture. The urbanized areas of the Cow Creek Basin are found primarily in the residential communities of Kelly Greens, Palmetto Park, and Indian Creek Park. The remainder of the basin (71%) is undeveloped and includes predominantly wetlands. Only 4% of the basin is open water. The discussion of management practices is divided into urban and agricultural management practices.

4.6.5.1 Urban Management Practices

Urban water uses include public water supply and recreational uses. Water use information is from the SFWMD permit files. There are no permitted public water supply facilities in the Cow Creek Basin. Urban water management permits are listed in Table 4-26 and a description of each is provided below.

Industrial land use in the Cow Creek Basin covers 162 acres, or approximately 2% of the basin area. The FDEP databases list 111 domestic point sources and 13 industrial point sources in Lee County.

Table 4-26. Permitted maximum allowable permitted discharges (cfs) in the Cow Creek Basin.		
PERMIT NUMBER	ACRES SERVED	PERMITTED DISCHARGE (cfs)
36-00444-S	32.6	4

Table 4-26. Permitted maximum allowable permitted discharges (cfs) in the Cow Creek Basin.		
PERMIT NUMBER	ACRES SERVED	PERMITTED DISCHARGE (cfs)
36-00511-S	9.6	2
36-00352-S	53.5	8
36-00185-S	70	20
36-00228-S	8.83	1
36-00219-S	29.0	15.8
36-00532-S	19.66	12
36-00476-S	31.8	16
36-00469-S	43.9	9
36-00384-S	312.0	45
36-00472-S	6.59	1

San Carlos Bay Area

SFWMD Permit No. 36-00444-S is issued to Bunche Beach and 869 Partnership No 1 for the construction and operation of a surface water management system serving Summerlin Gateway (144 multi-family dwelling units, a 125-unit motel, and a restaurant). Located in S11/T46S/R23E, the total land area is 32.6 acres. Stormwater runoff will be directed via swales, inlets, and culverts to a 5.2-acre onsite lake, with eventual discharge to San Carlos Bay. Discharge from the lake is through approximately 200 LF of 14-inch x 23-inch ERPC culvert, one 10.0-inch diameter orifice with an invert at elevation 2.5-feet NGVD and 70 LF of 14-inch x 23-inch ERCP culvert to the ditch along Bunche Beach Road. Permitted discharge is 4 cfs.

Hurricane Bay Area

SFWMD Permit No. 36-02376-S is issued to C.R. Stevens, Inc. (Bayside Estates) for the construction and operation of a surface water management system serving residential lands. Located in S7/T46S/R24E, the total land area and project encompass 35.4 acres. Drainage facilities include one 1.42-inch wide sharp crested weir with a crest elevation at 2 feet NGVD and 60 LF of 2.5-inch diameter RCP culvert. Runoff is routed to Hurricane Bay via a canal that is permitted herein. The canal is tidally influenced. No permitted discharge datum was available.

Pelican Bay Area

SFWMD Permit No. 36-00511-S is issued to Boardwalk Caper Ltd. Partnership for the construction and operation of a surface water management system of interconnected dry retention areas serving the Boardwalk Caper Condominiums. Located in S13/T46S/R23E, the total land area encompasses 9.6 acres. Drainage facilities include a control structure/triangular orifice with a bottom elevation of 4.0 feet NGVD, a top elevation of 5.2 feet NGVD, and a top width of 9.0 inches. Discharge will be through 10 LF of 12-inch by 18-inch RCP culvert into the existing tidal waterway, with eventual outfall to Pelican Bay. Permitted discharge is 2 cfs.

San Carlos Bay Area

SFWMD Permit No. 36-00352-S is issued to Rufus Dodrill for the construction and operation of a surface water management system serving Siesta Bay, a residential project. Located in S12/T46S/R23E, the total land area is 53.5 acres. Runoff is directed to an onsite lake used for detention purposes, with the outfall via an existing swale that eventually drains into San Carlos Bay. Drainage facilities include one 2.0-foot wide weir with a crest elevation of 4.1 feet NGVD, and one 87-degree V-notch bleeder with a vertex at elevation 3.0 feet NGVD. Discharge is routed through 88 LF of 36-inch diameter RCP culvert leading to an existing swale along an existing railroad grade. Allowable discharge is 8 cfs.

SFWMD Permit No. 36-00185-S is issued to Aloha Land Yacht Harbor for the construction and operation of a surface water management system serving a development of travel trailer spaces and associated facilities. Located in S12/T46S/R23E, the total land area is 70 acres. A previous permit approved a system of grassed swales and culverts to collect runoff and direct it to the 11.5-acre onsite lake. The direct outfall from the lake was to I.D.D Canal "D-2" through a 6-foot wide weir. A modified outfall structure has been authorized. Drainage facilities currently include one 4.67-foot wide weir with a crest elevation of 3.2 feet NGVD, and one 5.5-inch wide bleed-down slot at an invert elevation of 2.0 -foot NGVD. Discharge from the control structure is routed to San Carlos Bay with eventual drainage to Gulf of Mexico. Permitted discharge is 20 cfs.

Estero Bay

SFWMD Permit No. 36-00228-S is issued to Joel E. Fowler of Indian Creek Park – Phase V for the construction and operation of a surface water management system serving Indian Creek Park Recreational Complex. Located in S7,12/T46S/R23,24E, the 8.83-acre drainage area is within a total project area of 92.7 acres. Permitted facilities consist of an onsite lake, one 3.1-foot wide weir, one 32 LF x 12-inch x 18-inch perforated RCEP culvert and one 3 -foot x 10 -foot x 20 -foot rock trench discharging via sheetflow. Sheetflow is directed to swales along San Carlos Boulevard, then to Estero Bay, with eventual drainage into the Imperial River. Allowable discharge is 1 cfs for this phase only.

SFWMD Permit No. 36-00400-S is issued to Mariner Properties, Inc. for the construction and operation of a surface water management system serving Seaview Park, a commercial/industrial project. Located in S9/T46S/R23E, the total land area of the project consists of 72.5 acres. Permitted drainage facilities include a storm sewer and rock-filled trench system, dry detention areas, and 15 control structures as follows:

Basin A: One 11-foot wide weir and four 9.8-foot wide weirs with crest elevations of 5.0 feet NGVD, and V-notch bleeders at invert elevation 3.0 feet NGVD;

Basin B: Eight 11-foot wide weirs with crest elevations of 5.0 feet NGVD, and V-notch bleeders at invert elevation 3.0 feet NGVD; and

Basin C: Two 4.5-foot wide weirs with crest elevations of 4.5 feet NGVD, and V-notch bleeders at invert elevation 3.5 feet NGVD.

The weirs discharge into 10-foot x 10-foot rock or riprap spillways. Stormwater spillways discharge via San Carlos Bay into the Gulf of Mexico. Unlimited discharge is allowed.

SFWMD Permit No. 36-00219S is issued to U. S. Home Corporation for the construction and operation of a surface water management system serving Cinnamon Cove, a residential project. Located in S6/T46S/R24E, the project consists of a 29-acre drainage area within a total project area of 118.5 acres. The project was originally permitted for an onsite lake system and one 15-inch diameter RCP bleeder pipe discharging into Iona Drainage District's "D-2" canal with eventual flow to San Carlos Bay. Permitted discharge is 15.8 cfs.

SFWMD Permit No. 36-00755-S, as modified, is issued to Bruce D. Robertson for Old Pelican Bay, Inc. to relocate previously permitted retention areas and to extend the entrance road for residential lands. The relocation of both dry retention areas will place them in close proximity to wetlands. All activities were conducted landward of the wetlands. Located in S12,13/T46S/R23E, the project includes a 37-acre drainage area within a total project area of 13.36 acres. The area affected by the modification includes a drainage area of 0.10 acres within a 4.14 project area. Drainage facilities include one 2-foot wide weir with a crest elevation of 4.8 feet NGVD and one 2-foot wide weir with a crest elevation of 4.5 feet NGVD. Overflow from detention areas discharge into San Carlos bay, with eventual outflow to Estero Bay. Permitted discharge is not applicable.

SFWMD Permit No. 36-00160-S is issued to Lakeside Homeowner's Association for the construction and operation of a water management system serving residential lands. Located in S7/T46S/R24E, the project consists of 1.4 acres of drainage area within a total land area of 16.4 acres. Water is directed by roadside swales, storm sewer inlets and pipes to a retention area. Discharge structures include one 1.5-foot wide weir with a crest elevation of +4.1 feet NGVD, and one 2.5-square inch bleeder slot at elevation 2.5 feet NGVD, and a 15-inch CMP culvert that outfalls to the northern

drainage ditch. Runoff is directed to Iona Drainage District's Canal "D-2" into San Carlos Bay. A discharge of 2.4 cfs is expected.

SFWMD Permit No. 36-00532-S is issued to Rufus M. Dodrill for the construction and operation of a surface water management system serving Siesta Bay Phase II, a recreational vehicle park. Located in S12/T46S/R23E, the project consists of a 19.66-acre drainage area.. Permitted control structures include one 1.5-foot wide weir with a crest elevation of 3.7 feet NGVD, one 102-degree V-notch bleeder with and invert elevation of 3.0 feet NGVD and 60 LF of 24-inch diameter RCP culvert. Runoff is directed via a system of inlets, culverts, and swales to the existing 2.94 acre lake. The system discharges to a roadside swale, then to San Carlos Bay. Permitted discharge is 12 cfs.

SFWMD Permit No. 36-00476-S is issued to Summerlin Partnership for the construction and operation of a surface water management system serving the Summerlin Square, a shopping center and parking lot. Located in S7/T46S/R24E, the total project area is 31.8 acres.. Drainage facilities include 1.1 acres of wet detention with one 1.2 -foot wide weir at a crest elevation of 5.85 feet NGVD. The bleeder is one 20-degree V-notch with invert elevation of 4.5 feet NGVD. Discharge is routed through 60 LF of 24-inch diameter CMP culvert to existing agriculture ditches. The 3.0 acres dry detention are permitted for a system consisting of one 1.2-foot wide weir with crest elevation of 6.6 feet NGVD. The bleeder is one 30-degree V-notch at an invert elevation of 5.5 feet NGVD. Runoff is directed from wet and dry detention to tributaries that flow to San Carlos Bay and eventually Estero Bay. Allowable discharge is 16 cfs.

SFWMD Permit No. 36-00469-S is issued to M.A. Yakubik, Trustee, for the construction and operation of a surface water management system serving Long Lake Condominium. Located in S12/T46S/R23E, the project consists of a 43.9-acre drainage area within a total project area of 59.7 acres. A 15.8-acre mangrove area is preserved and is excluded from the drainage system. Drainage facilities include: one special inlet with one 13-inch wide weir with crest elevation of 3.5 feet NGVD, one 5-inch wide vertical bleeder notch with and invert elevation of 3.0 feet NGVD, and 30 LF of 18-inch diameter RCP culvert; and one special inlet with one 13-inch wide weir with a crest elevation of 3.5 feet NGVD, and 30 LF of 18-inch diameter RCP culvert. Runoff discharges into San Carlos Bay via existing mangrove areas. Permitted discharge is 9 cfs.

SFWMD Permit No. 36-00384-S is issued to Kelly Green Development Corporation for the conceptual approval of the master drainage plan, and construction and operation of a surface water management system serving Kelly Greens. Located in S1/T46S/R23E, this multi-phased residential and recreational (golf course) development was originally permitted in 1983. The total land area is 312 acres and the first authorized construction involved 151.4 acres for the golf course and 110 residential units. In a later phase, 315 multi-family units were added. Also, a 4.98-acre wetland creation area was constructed within the golf course boundaries to satisfy requirements by Lee County.

Drainage facilities include grassed swales, catch basins, an internal lake system, and three weirs (one 1-foot wide, one 2.75-foot wide and one 3.0-foot wide). A spreader swale discharges into one 55-foot x 30-inch diameter and one 55-foot x 36-inch diameter CMP culverts, one 250-foot x 24-inch x 38-inch RECP culvert and two 12-foot x 5-foot double box culverts. The box culverts were existing and discharge via an existing ditch into San Carlos Bay. Permitted discharge is 45 cfs.

The water use permit (*SFWMD Permit No. 36-00455-W*) authorizes withdrawals of water for irrigation use.

SFWMD Permit No. 36-00472-S is issued to Richard Hartung for the construction and operation of a surface water management system serving Indian Creek Shopping and the parking lot. Located in S7/T46S/R24E, the project area encompasses 6.59 acres. Drainage facilities include catch basins connected to 1609 LF of exfiltration trench consisting of one 12-inch diameter perforated PVC culvert with invert elevation 4.0 feet NGVD, in a 3.5-foot high x 7-foot wide rock filled trench. The exfiltration trench overflows into a 0.27-acre dry detention area. Discharge is through a control structure consisting of one 4-inch diameter orifice with an invert elevation of 2.5 feet NGVD, and then through 90 LF of 12-inch x 18-inch RCPA culvert to the existing roadside ditch. The roadside ditch discharges into San Carlos Bay and eventually to Estero Bay. Allowable discharge is 1 cfs.

4.6.5.2 Agricultural Management Practices

Less than 1% of the Cow Creek Basin is occupied by agricultural land uses (Table 4-25) and includes only cropland and pastureland land use designations. There are no permits for agricultural irrigation withdrawals in the basin. Estimated acreages of irrigated crops in the basin are limited to 24 acres of improved pasture.

4.7 Hendry Creek

The Hendry Creek Basin includes approximately 11,623 acres of the Estero Bay Watershed in coastal Lee County and is located along the length of Hendry Creek from Estero Bay to College Parkway and Woodland Boulevard. The northern and northwestern portions of the basin include residential and commercial areas. The soils, hydrology, land use, drainage features and land use of the Hendry Creek Basin are described in the following sections.

4.7.1 Topography

The Hendry Creek Basin is relatively flat and ranges in elevation from sea level to about 5 feet above MSL in some small areas in the northwesternmost portions of the basin. Most of the basin is at or

below 5 feet in elevation, including populated areas in the basin. The lowest areas occur along the coast and are associated with Estero Bay and the wetlands along Hendry Creek.

4.7.2 Soils

General soils types in the Hendry Creek Basin are similar to those in the Cow Creek Basin. Soils are composed of the coastal Holocene sediments and undifferentiated shell beds in the interior portion of the basin. Anthropogenically altered or arent soils, e.g., dredge and fill, shell mounds, and landfills are also included within the basin.

Less than five percent of the soils in the basin is classified as very well-drained, well drained, to less well-drained (HSG designations A, B, and C), while 96% is classified as D (poorly drained) (Table 4-27).

The drainage characteristics and associated vegetation of the soils within the Hendry Creek Basin were described previously in Section 2.4. This section presents the detailed USDA SCS soil information as compiled in a GIS database for the Estero Bay Watershed. This information has been combined with updated 1995 land use data in order to model surface water hydrology for the basin.

Soils of the Hendry Creek Basin are primarily Peckish-Estero Isles soils characteristic of tidal areas and barrier islands. These soils are nearly level, very poorly drained, and mucky, although some have a sandy, organic-stained subsoil and some have a loamy subsoil. The interior portion of the basin where development has occurred includes Immokalee-Pompano soils characteristic of flatwoods and sloughs.

The majority of the individual soils series within the 11,056 acre basin have been assigned an HSG value of D (Plate 4-13). These soils total approximately 10,633 acres (Table 4-27). Group D soils have very slow infiltration rates when thoroughly wetted, thus, the runoff within the basin is expected to be high. These soils are primarily clay with a high permanent water table or shallow soils over nearly impervious materials, such as a clay pan or clay layer.

The remaining soils are designated as Group C and have moderate to high runoff potential. These are the more interior soils with slow infiltration rates when thoroughly wetted, often with a layer of soil that impedes the downward movement of water. These soils make up only 4% (423 acres) of the soil types in the basin. Boca and Hallandale fine sands, which can support saw palmetto and slash pine under naturally occurring conditions, are located in the more developed northern portion of the basin.

Table 4-27. Hydrologic soil groups in the Hendry Creek Basin.		
Hydrologic Soil Groups	AREA (acres)	PERCENT COVER
A	2,015	1%
B	846	<1%
C	423	4%
D	10,633	96%
TOTAL	11,056	100%

4.7.3 Existing Land Use

Existing land use acreages for the Hendry Creek Basin are presented in Table 4-28. A map of existing land use for the basin is presented in Plate 4-14. Land uses classes listed in both the table and map are grouped as developed (urban and agriculture), undeveloped (natural land cover), and water.

Land use in the Hendry Creek Basin is divided nearly equally between developed and undeveloped land uses. Although 44% (5,146 acres) of the basin lands is developed as urban or agriculture, only 5% is in agriculture. Agricultural uses are concentrated along northeastern portion of the basin which also coincides with the locations of several flowing wells.

Approximately 20% of the total land use (2,357 acres) is residential, primarily medium and high density communities such as those mentioned earlier. Residential communities of The Forest, Devonwood Estates, Pinebrook, Cypress Lake Center, and Fort Myers Villas are located in the northern portion of the basin. Commercial and industrial uses are located primarily along Cypress Lake Drive and the Six-Mile Cypress Slough Parkway and make up less than a thousand acres of the basin (8%), and all remaining developed land uses make up 11% of the basin land use.

Undeveloped land cover makes up 50% (5,786 acres) of the total basin. Undeveloped land cover is primarily wetlands (33% of the basin land use) and these wetlands are predominantly wetland hardwood forests (2,539 acres, 22%). Water, including streams, sloughs, reservoirs, lakes, and bays and estuaries, makes up the remaining 691 acres (6%) in the basin. A former rock quarry at the northern tip of Hendry Creek makes up nearly 200 acres of disturbed land in the basin.

A discrepancy in total acres between soils and land use occurs as a result of this quarry being designated as water in the soils map, while being designated as disturbed land for land use purposes. The former quarry is also a recreation and community facility for the area.

Table 4-28. Land use and land cover in the Hendry Creek Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Residential		
Residential Low Density	553	5%
Residential Medium Density	854	7%
Residential High Density	692	6%
Residential - Mobile Homes	258	2%
Subtotal	2,357	20%
Commercial/Industrial		
Commercial and Services	469	4%
Industrial	437	4%
Institutional	9	<1%
Subtotal	915	8%
Recreation and Open Land		
Recreational	420	4%
Open Land	377	3%
Subtotal	797	7%
Transportation and Utilities		
Transportation	202	2%
Utilities	18	<1%
Subtotal	220	2%
Agriculture		
Cropland and Pastureland	374	3%
Nurseries and Vineyards	244	2%
Subtotal	645	5%
Disturbed Land		
Disturbed Lands	212	2%
Subtotal	212	2%
TOTAL DEVELOPED LANDS	5,146	44%
Upland Forested		
Upland Coniferous Forests	1,626	14%
Upland Hardwood Forests	349	3%
Subtotal	1,975	17%
Shrublands and Brushlands	27	<1%

Table 4-28. Land use and land cover in the Hendry Creek Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Wetlands		
Wetland Hardwood Forests	2,539	22%
Wetland Coniferous Forests	11	<1%
Vegetated Non-Forested Wetlands	1,103	9%
Non-Vegetated	158	1%
Subtotal	3,811	33%
TOTAL UNDEVELOPED LANDS	5,786	50%
Water		
Lakes	25	1%
Streams and Waterways	248	2%
Bays and Estuaries	253	2%
Reservoirs	147	1%
Slough Waters	18	<1%
Subtotal	691	6%
TOTAL	11,623	100%

4.7.4 Geologic and Drainage Features

The Hendry Creek Basin is characterized by surface and subsurface drainage features that interact with each other. There is a network of canals in the basin which provide stormwater and groundwater drainage for primarily residential areas, which make up approximately 20% of the land use in the basin. More than a third of the basin includes undeveloped wetlands. The existing geologic and drainage systems are discussed in the following sections.

4.7.4.1 Hydrogeology

There are three major aquifer systems underlying the Estero Bay Watershed, including the Hendry Creek Basin. These are the:

- ! Surficial Aquifer System,
- ! Intermediate Aquifer System, and
- ! Floridan Aquifer System.

The Surficial Aquifer is the uppermost aquifer and includes the water table aquifer, confining beds, and the lower Tamiami aquifer; the water table aquifer and the lower Tamiami aquifer are the two main water bearing formations. The water table aquifer is an unconfined aquifer of primarily undifferentiated sands, shell beds, calcareous clays, and some limestone. The semi-confining Tamiami confining zone separates the water table aquifer from the Lower Tamiami Aquifer.

The Surficial Aquifer is the most significant aquifer system since it is the closest to the surface and is at times in direct connection with surface water. The potentiometric surface of this aquifer follows land surface contours and for undrained areas, wet season water levels are seldom less than 3 feet above or below land surface. The water level in the water table aquifer and Lower Tamiami Aquifer in the Hendry Creek Basin does not exceed 8 feet throughout the basin (SFWMD, 1990).

Thickness of the Surficial Aquifer varies between 25 and 50 feet in central Lee County to and thickens toward the southeastern part of Lee County. Movement in the Surficial Aquifer is generally southwest and provides water for baseflow for major streams and rivers in the basin.

In areas where the underlying Hawthorn confining zone is thin or absent the Surficial Aquifer is in direct hydraulic connection with the Sandstone Aquifer. The upper Hawthorn confining zone separates the Surficial Aquifer from the Sandstone Aquifer in most of Lee County and ranges from 0 to 25 feet below the surface in the central portion of the basin and the thickness decreases farther south and is absent near Bonita Springs. The Sandstone Aquifer ranges between 0 and 10 feet in the Hendry Creek Basin.

The Intermediate Aquifer, also called the Hawthorn Aquifer, lies below the Surficial Aquifer and is comprised of the five major units listed below. The two water producing zones of this system are the Sandstone and Mid-Hawthorn aquifers (SFWMD, 1982).

- ! Upper Hawthorn Confining Zone,
- ! Sandstone Aquifer,
- ! Mid-Hawthorn Confining Zone,
- ! Mid-Hawthorn Aquifer, and
- ! Lower Hawthorn/Tampa Confining Zone.

The Floridan Aquifer underlies all of Florida. The top of the Floridan Aquifer is associated with the lower Hawthorn Formation and the Tampa formation, the top of which ranges from -350 feet in northwestern Lee County to -700 feet in the southern portion of the county. The potentiometric surface of the Mid-Hawthorne Aquifer ranges from 10 feet NGVD along the coastal portion of the Hendry Creek basin to nearly 40 feet NGVD along the eastern boundary.

The Sandstone Aquifer underlies the upper Hawthorn confining zone throughout nearly the entire basin. The top of this unit occurs between 10 and 20 feet NGVD from the coastal areas to the

northeastern boundary in the Hendry Creek Basin (SFWMD, 1990). In the northern part of the Estero Bay Watershed, the aquifer surface lies between 25 and 50 feet NGVD, but it dips in a southerly direction to 150 feet below the surface in the southeastern portion of Lee County.

The Tamiami and Hawthorn formations are approximately 40-580 feet in thickness in Lee County. These formations occur as limestones and dolomites and serve as reservoirs for the Tamiami and upper Hawthorn aquifers which supply freshwater. The Lower Hawthorn Aquifer water supply is highly saline (SWRPC, 1995).

4.7.4.2 Surface Drainage

Surface drainage is dependent on groundwater levels, rainfall, and the drainage network characteristics. Groundwater inflows and rainfall are inputs to the surface water hydrologic system, whereas the drainage network controls the output. Rainfall and surface drainage are discussed here.

The Hendry Creek Basin is drained by Hendry Creek and other small drainage conveyances into northern Estero Bay. Much of the northern portion of the basin drains to a quarry lake north of Gladiolus Drive, which then flows into the upper tributaries of Hendry Creek. Canals in the basin are associated with residential areas and empty into several creeks, including Phillips Creek, the East Fork, and Big Bayou, before flowing to Hendry Creek and north Estero Bay.

4.7.5 Management Practices

Approximately 44% of the Hendry Creek Basin is classified as urban land (Table 4-28). The urbanized areas of the basin are found primarily in the communities located in the northern and northwestern portions of the basin. The discussion of urban management practices is divided into urban water uses and urban water discharges. The water uses and water discharges are tabulated in the following descriptions. Water withdrawals are predominantly for agricultural use, while surface water management systems are generally for residential and commercial purposes.

4.7.5.1 Urban Management Practices

Developed land uses in the Hendry Creek Basin include 5,146 acres (41%) in the basin. Of this, residential land use makes up 2,357 acres (20% of the basin). Groundwater withdrawals permitted in the basin for urban use are generally for landscape irrigation. Table 4-29 lists the groundwater withdrawals permitted in the basin, based on permit files obtained from the SFWMD. Summaries of permits are also provided below.

Table 4-29. Groundwater withdrawals permitted in the Hendry Creek Basin.		
PERMIT NUMBER	ACRES SERVICED	ANNUAL ALLOCATION
36-00161-S/W	Mid-Hawthorn Aquifer	72.64 MG
36-00278-S/W	Lower Hawthorne Aquifer	69.6 MG

The Hendry Creek Basin includes 11,623 acres and is located west of Ten-Mile Canal Basin, northwest of Mullock Creek Basin, north of Estero Bay and east of Cow Creek Basin. According to the District permit data base, the following water use and surface water management permits have been issued.

SFWMD Permit No. 36-00057-S is issued to Keith Miller, Trustee, for construction of the surface water management system on commercial lands known as Lakeridge Park. The permit pertains specifically to 22 acres of the 250-acre total land area, which in this case is a quarry lake. The permit was later amended on May 8, 1980 to include 18 additional acres. The project is situated in S26/T45S/R24E. Discharge is into the quarry lake at the southwest corner, then to Hendry Creek. Permitted treatment areas are grassed swales. Other construction phases also are permitted to discharge into the large lake: *SFWMD Permits 36-00420-S, 36-00465-S, 36-00466-S and 36-00539-S*. Related permits cover property that was originally one project. The subdivision plat shows drainage easements dedicated to the public. Therefore, the five parcels have legal access to the Lakeridge Park surface water management system.

SFWMD Permit No. 36-00161-S/W is issued to The Forest Country Club, Inc. and includes a water use permit and renewals, as well as multiple phases of a surface water permit. The existing water use permit is for the continuation of the use of groundwater and surface water for golf course irrigation. Located in Fort Myers, the project is situated in Sections 1 and 2/T46S/R24E. The source of groundwater is the mid-Hawthorn Aquifer, and surface water is withdrawn from Lake No. 2 and Deer Lake. Of a total land area of 611 acres, the irrigated area affected by this permit is 160 acres. The permitted annual allocation of irrigation water is 72.64 million gallons. Water quality monitoring is required. Groundwater facilities include 2 - 6-inch x 150 gpm wells cased to 180 feet, and six turbine pumps as follows:

- 1 - 6-inch x 15 HP x 140 gpm
- 2 - 12-inch x 75 HP x 700 gpm
- 1 - 6-inch x 10 HP x 100 gpm
- 2 - 10-inch x 60 HP x 500 gpm

The existing surface water permit authorizes construction of a surface water management system for The Forest, a multi-phased residential project that is associated with the above golf course. Water's Edge Condo and Eagle Creek are representative units. The water management system serves 263

acres of lands by grassed swales, retention lakes and outfall structures discharging via the IONA Drainage District's Canals into Hendry Creek. Discharge facilities include:

1 - 5.5-foot wide weir with a crest at elevations 3.7 feet NGVD, 1 - 8-inch diameter bleed-down pipe with an invert elevation of 2.0 feet NGVD, and 100 LF of 4-foot diameter culvert.

1 - 6.0-foot wide weir with a crest at elevations 3.5 feet NGVD, 1 - 16-inch diameter bleed-down pipe with an invert elevation of 2.0 feet NGVD, and 50 LF of 4-foot diameter culvert.

Surface water facilities include three turbine pumps at Lake No. 2 and three at Deer Lake, as follows:

Lake No. 2:

- No. 1 6-inch diameter x 15 HP x 140 gpm (rated capacity)
- No. 2 12-inch diameter x 75 HP x 700 gpm (rated capacity)
- No. 3 12-inch diameter x 75 HP x 700 gpm (rated capacity)

Deer Lake:

- No. 4 6-inch diameter x 10 HP x 100 gpm (rated capacity)
- No. 5 10-inch diameter x 60 HP x 500 gpm (rated capacity)
- No. 6 10-inch diameter x 60 HP x 500 gpm (rated capacity)

SFWMD Permit No. 36-00175-S is issued to Uniprop - Jamaica Bay Associates, LTD. for its Jamaica Bay West project. A 181-acre, phased mobile home community, this project has sought several permit modifications to the master plan. Modifications regard finished floor elevations, project ownership, construction of a recreation building, a new outfall structure and modifications to the existing structure. The project, situated in S36/T45S/R24E, discharges via a system of inlets, culverts, swales and retention area into the east branch of Hendry Creek and IDD Canal "I-1."

The west structure is a .068-foot wide weir with crest elevation of 6.4 feet NGVD, one 6-inch diameter bleeder with an invert at 4.5 feet NGVD. The receiving water is the east branch of Hendry Creek. The north structure has an identical design and 40 LF of 30 inch RCP discharge culvert. The receiving water is the IDD Canal I-1.

SFWMD Permit No. 36-00177-S is issued to Alan Fox, Trustee, The Pines for construction of the surface water management system in Phase I of an 80-acre commercial project. The permit pertains to 13.4 acres of water management area of 33.4 acres of project area. The project is situated in S24/T45S/R24E. Discharge is directed south in the Daniels Road ditch to Hendry Creek. Permitted facilities include 13.4 acres of retention, one 4-foot rectangular weir with a crest elevation of 8.3 feet NGVD, and one 1-foot v-notch bleeder with invert elevation of 5.0 NGVD. See also permits 36-00210-2 and 36-00211-S.

SFWMD Permit No. 36-00210-S is issued to Bell Tower Mall for the construction of a surface water management system associated with a commercial project. The permit pertains to 60 acres of total land area. The project is situated in S24/T45S/R24S. Water management for Bell Tower Mall is provided by The Pines (Permit No 36-00177-S), which this project outfalls to. Water quality and quantity calculations for the Pines assumed 100 percent impervious for this 60 acres known as Bell Tower Mall. Discharge is via a county ditch along Daniels Road, then into Hendry Creek. Permitted structures include one 4-foot rectangular weir with crest elevation of 8.3 feet NGVD, and one 1-foot v-notch bleeder with crest elevation of 5.0 feet NGVD (Permit No. 36-00177-S).

SFWMD Permit No. 36-00211-S is issued to Pinebrook Lakes for construction and operation of a surface water management system of residential lands. The permit pertains to 18.2 acres of water management area, a 34.8-acre project area, and a 135-acre total land area. The project is situated in S24/T45S/R24E and the existing facilities include the same 13.4-acre lake constructed under a previous permit, for other projects (The Pines and Bell Tower Mall). Also, thirty acres of a subdivision to the north will use the lake system and has been included in the drainage calculations. Further, Lee County Utilities will supply water to this project. The permitted allocation for Lee County Utilities is 7.12 MGD and present withdrawal is 4.69 MGD. This project will have a demand of 0.22 MGD. Discharge is directed to the Daniels Road ditch, then into Hendry Creek. Permitted structures are a 4.0-foot wide concrete weir with a crest elevation of 8.4 feet NGVD, and a 12-inch wide v-notch bleeder slot at elevation 5.0 feet NGVD.

SFWMD Permit No. 36-00214-S is issued to U.S. Home Corporation for the construction and operation of the Cypress Lakes Condominium-surface water management system. The project includes 37 acres of total land area and 5 acres of water management area. Cypress Lakes Condominium is situated in Sections 27 and 34/T45S/R24E. Stormwater is discharged via a system of inlets and culverts, and an onsite lake into the Iona Drainage District Canal. An eventual discharge into Hendry Creek exists. Permitted structures include a 36-inch RCP culvert with an 18-inch wide weir having a bleeder slot at elevation 2.5 feet NGVD and crest elevation at 3.1 feet NGVD.

SFWMD Permit No. 36-00223-S is issued to Lennar Homes, Inc. for construction and operation of the surface water management system at Royal Woods, a residential development in Fort Myers. The permit pertains to 4.7 acres of water management lands and a total land area of 40 acres. Situated in S12/T46S/R24E, the project discharges to Hendry Creek via the former IDD "U" Canal via an onsite lake system. Permitted structures include one 1.5-foot wide weir with a crest elevation of 3.9 feet NGVD; a 1.05-foot x 1.47-foot wide triangular orifice with invert elevation 2.2 feet NGVD; and 36 LF of 21-inch diameter CMP discharge culvert.

SFWMD Permit No. 36-00255-S was originally issued to the Lee County Board of County Commissioners in 1982 for construction and operation of a surface water management system on recreational lands known as The Lakes. In 1991, application to modify the permit and ownership

was made and approved. *SFWMD Permit No. 36-00255-S* is now issued to James Lavender for a recreational project known as Lakes Regional Park - Skateboard Facility and Pavilion.

The project, which contains 158 acres of water management area out of a 279-acre total land area, is located in S26/T45S/R24E. Outflow is conducted to tributaries of Hendry Creek. Hendry Creek is tidal along Gladiolus Drive. There are two off-site pumps in the Seven Lakes development to the north which discharge into this project area with a combined rated capacity of 6,000 gpm. The permitted structures consist of Control Structures 1, 2, and 3 as well as a levee extending east and south from structure No. 1. A channel will conduct flows out of the southeast lake to three proposed 10 feet x 7 feet box culverts under a relocated-Gladiolus Drive.

Control structure 1 has V-notch bleeder with an invert elevation of 2.5 feet NGVD, crest elevation of 4.0 feet NGVD, crest width of 40 feet, and maximum gate area of 2 @ 10 square feet each. Structure 2 has V-notch bleeder with invert elevation of 2.5 feet NGVD, crest elevation of 4.0 feet NGVD, crest width at 100 feet, and maximum gate area of 2 @ 20 square feet each. Structure 3 has V-notch bleeder with invert elevation of 2.5 feet, crest elevation of 3.0 feet NGVD, crest width of 40 feet, and maximum gate area of 2 @ 10 square feet each.

SFWMD Permit No. 36-00278-S/W The water use permit, issued to Paddle Creek Enterprises, Inc. for Paddle Creek Square, authorizes use of groundwater from the Lower Hawthorne Aquifer and surface water from an on site lake system for landscape irrigation. The system serves 22.1 acres with a monthly withdrawal of 5.8 million gallons. The project is located in S34/T45S/R24E. The water use permit specifies that the permittee shall mitigate any adverse impact caused by withdrawals.

Withdrawal facilities include a 6 inch x 650-foot production well cased to 450 feet, and a 4-inch x 200 feet production well. Surface water management system is for residential lands. The surface water permit pertains to 38.1 acres total land area. Outfall is through an existing drainage ditch to Hendry Creek. Permitted discharge facilities include one 3-foot wide weir with a crest elevation of 5.0 feet NGVD, one 8-inch diameter bleeder pipe at elevation 4.0 feet NGVD, and 70 LF of 24-inch diameter RCP culvert., 1985 LF of 12-inch diameter perforated plastic pipe laid in 3 feet x 5.5 feet rockbeds and 27 LF of 6-inch PVC pipe.

SFWMD Permit No. 36-00297-S is issued to First Communities of Ft. Myers, Inc. for the construction and operation of a surface water management system at Island Park Village, a 380-unit residential community. Originally issued in 1982, the permit pertains to 140 acres total land area. Phased construction was authorized by several permit modifications, and the stormwater management system was last modified in 1987. Modifications have involved increases in weir crest elevations and other control structure dimensions, the water management area, the methods of discharging into wetlands, and the area impervious surface. The project is situated in S12/T46S/R24E, and its treatment ponds discharge via onsite wetlands into Hendry Creek. Permitted structures are for four basins, as follows:

Basin 1 -- one 3.0-foot wide weir with a crest at elevation 3.64 feet NGVD, and one 80 degree V-notch bleeder with invert elevation at 2.5 feet NGVD. Discharge is via a 20-foot wide spreader swale into onsite wetlands, before outfalling to Hendry Creek.

Basin 2 -- one 3.0-foot wide weir with a crest elevation of 3.0 feet NGVD, and one 60-degree V-notch bleeder with invert elevation of 2.5 feet NGVD. Discharge is via a 20-foot wide spreader swale into onsite wetlands, before outfalling to Hendry Creek.

Basin 3 -- one 2.25-foot wide weir with a crest elevation of 3.4 feet NGVD, and one 4-foot diameter bleeder hole at elevation 2.0 NGVD. Discharge was originally permitted to outfall through 35 LF of 36-inch diameter CMP culvert into onsite wetlands and to Hendry Creek.

Phase I -- one temporary structure consisting of a 0.8-foot wide weir, a crest elevation of 4.0 feet NGVD, one 3-inch diameter bleeder hole at elevation 2.5 feet NGVD, and 20 LF of 24-inch diameter CMP culvert.

SFWMD Permit No. 36-00305-S is issued to Harper Brothers, Inc. for the construction and operation of a surface water management system at Harper (Six-Mile) Commercial Park, a light industrial development. The permit pertains to 69.13 acres of total land area. The project is situated in S25/T45S/R24E. Permitted structures are one 1.4-foot weir with a crest elevation of 8.3 feet NGVD, one 0.5-foot bleeder slot with a crest elevation of 7.5 feet NGVD, and 160 LF of 24 inch diameter RCP culvert with invert elevation of 7.5 feet NGVD.

SFWMD Permit No. 36-00316-S is issued to R.Z.D., Inc. for the construction and operation of a surface water management system at Gladiolus Gardens Condominiums, a residential project in Fort Myers. With a total land area of 12.6 acres, the project is located in S34/T15S/R24E. Receiving body is Hendry Creek. Permitted structures are three discharge structures with one 4 inch diameter bleeder hole at elevation 2.5 feet NGVD, and various lengths of 8-inch diameter PVC pipe. Stormwater discharge is routed to Hendry Creek via a roadside swale and an existing canal.

SFWMD Permit No. 36-00329-S is issued to Island Park Estates for the construction and operation of a surface water management system at Newport Glen, a residential development. With a total land area of 19.7 acres, the project is located in S12/T46S/R24E. Permitted structures are one 2-foot wide weir with a crest elevation of 4.1 feet NGVD, one 37-degree V-notch weir with the apex at elevation 3.1 feet NGVD, 20 LF of 24-inch diameter CMP culvert, 25 feet of grassed swale, 30 LF of 24-inch diameter CMP culvert, and 90 LF of grassed swale. The recorded receiving body is Canal U of the defunct Iona Drainage District, which discharges to Hendry Creek.

SFWMD Permit No. 36-00359-S is issued to Leisure Technology, Inc. for the construction and operation of the surface water management system for Leisure Village at Seven Lakes, a residential, recreational, and commercial project. Also in the original permit, conceptual approval of the

remaining 55.84 acres was granted. Since the original permit, several modifications have been approved.

The total land area is 222 acres and the drainage area is 16.3 acres. The project is situated in S23/T45S/R24E. Discharge facilities are approved in two basins:

Northeast Nine Drainage System -- one 11.0-foot wide weir with a crest elevation of 9.0 feet NGVD, one 1.0-foot wide, 0.72-foot high, 70-degree triangular orifice with an invert elevation at 7.0 feet NGVD; 120 LF of 24-inch diameter RCP culvert, and 250 LF of 24-inch diameter CMP culvert. The receiving water is the Caloosahatchee River via Lee County drainage ditches and Whiskey Creek.

Leisure Village at Seven Lakes -- 38 LF of 24-inch diameter RCP intake culvert with an invert elevation of 2.8 feet NGVD, one 3500 gpm primary pump, one 3500 gpm back-up pump, 790 LF of 14-inch diameter CIP discharge line culvert. Discharge is routed to the IDD Canal "I", then to Hendry Creek.

SFWMD Permit No. 36-00361-S is issued to Golfside Limited for the construction and operation of a surface water management system at Golfside Condominium, a multi-family residential community. The permit pertains to 9.6 acres total land area. The project is situated in S12/T46S/R24E. The discharge structure consists of one 22.0-foot wide weir with crest elevation of 7.35 feet NGVD, one 0.8-foot wide weir with a crest at elevation 5.2 feet NGVD, and one 3.0-inch diameter orifice with invert elevation at 4.3 feet NGVD. The receiving water is Hendry Creek via an existing ditch.

SFWMD Permit No. 36-00390-S is issued to Harvey Youngquist, Trustee for the construction and operation of a surface water management system at Briarwood Industrial Park. The permit has been modified several times to allow for phased development. The permit pertains to a 3.15-acre drainage area, and a 29.95-acre total land area. The project is situated in S36/T45S/R24E. Drainage facilities include one 1.0-foot wide weir with a crest elevation of 7.0 feet NGVD, one 8.25-inch wide, 38-degree V-notch weir with an invert elevation at 6.0 feet NGVD, and 20 LF of 24-inch diameter CMP culvert. The receiving water is Hendry Creek via an existing swale.

SFWMD Permit No. 36-00409-S is issued to Michael Furen, Trustee, for the construction and operation of a surface water management system serving 35.97 acres at Lakewood Cypress, a mixed residential, commercial and industrial project. The project is located in S27/T45S/R24E. Permitted structures authorized for Basin 1 include one 9-inch wide weir with a crest elevation of 4.5 feet NGVD, one 1 4/5-inch wide x 10-inch high rectangular orifice with invert at elevation 3.0 feet NGVD, and 250 LF of 34-inch x 53-inch RCPA culvert.

In Basin 3, SFWMD authorized one 2.5-foot wide weir with crest elevation 5.0 feet NGVD, one 1 4/5-inch wide x 10-inch high rectangular orifice with an invert elevation of 3.0 feet NGVD, and 120

LF of 38 inch x 60 inch RCPA culvert. The project discharges to the IDD Canal, then to Hendry Creek.

SFWMD Permit No. 36-00415-S is issued to Sun Bank of Lee County, NA for the construction and operation of a surface water management system serving 20 acres at Water Way Bay , a multi-family residential project. The permit pertains to 37 acres drainage area, with total project area of 20 acres. The project is situated in S12/T46S/R24E. Permitted structures are one 0.5-foot wide weir with a crest elevation of 4.5 feet NGVD, one 1.13-foot wide 59-degree V-notch weir with an invert elevation of 3.5 feet NGVD, first discharging through a circular 24-inch diameter port with an invert elevation of 3.75 feet NGVD to a swale, and then under Island Park Road through 48 LF of twin 15-inch diameter RCP culvert. The project discharges to the Iona Drainage District's Canal "U", then to Hendry Creek

SFWMD Permit No. 36-00420-S is issued to Fox Enterprises for the construction and operation of a surface water management system at an extension of Lakeridge Court, a road within a previously permitted commercial project. The original permit (Permit No 36-00057-S) was issued to Keith Miller, Trustee, for the 22-acre Lakeridge Park. Permit No. 36-00057-S was then modified on May 8, 1980 to include 18 additional acres. Runoff from the original permit was directed via grassed swales to an adjacent 250-acre quarry lake, then to Hendry Creek. The current project discharges in the same manner. The project is situated in S26/T45S/R24E. Permitted structures are 6 inch diameter PVC pipe.

SFWMD Permit No. 35-00425-S is issued to D & S Associates in 1984, for conceptual approval of a surface water management system serving a 110-acre project known as Pinebrook Lakes, and for construction and operation of Phases 2, 3 and 4. Conceptual approval of the project was originally authorized by Permit No. 36-00211-S, issued to J. Foster Pate, Trustee in 1980, who sold 110 acres of the 135-acre parcel to D&S Associates. owned by J. Foster Pate, Trustee and known as Phase 1. Pate still owns the remaining property.

Detention for the entire 135 acre parcel is provided by the existing 17 acres of lakes. One additional lake was excavated in Phase 2. Permitted structures are include one 4.0-foot wide concrete weir with a crest elevation at 8.4 feet NGVD, and one 12-inch wide V-notch bleeder slot with invert elevation 5.0 feet NGVD. Discharge is directed to the Daniels Road ditch, then to Hendry Creek.

SFWMD Permit No. 36-00454-S is issued to Cardinal Industries of Florida, Inc. for the construction and operation of a surface water management system at Pine Meadows Apartments, a multi-family residential project. The project has a 10.6-acre drainage area and a total land area of 13.4 acres. Located in S35/T45S/R24E, a 2.8-acre wetland is preserved adjacent to Phillips Creek. Permitted structures include a 2-acre dry retention area, one 8-inch diameter orifice with an invert elevation of 4.0 feet NGVD, 1729 LF of 6-inch diameter underdrain pipe at elevation 3.0 feet NGVD, and 20

LF of 18-inch diameter RCP culvert that discharges to 280 LF of spreader swales. The swales sheetflow into Phillips Creek wetlands, then Hendry Creek.

SFWMD Permit No. 36-00465-S is issued to John Scanlon, Sr. for the construction and operation of a surface water management system for Lakeridge Commercial Subdivision-Car Dealership and the four outparcels surrounding it. The permit pertains to 7.58 acres of total land area. The project is situated in S26/T45S/R24E.

This land was previously included in Permit No. 36-00057-S that was issued 8/10/78 for Lakeridge Park. Subsequent permits issued to John Scanlon, Sr. transferred 5.9 acres of project area from Permit No. 36-00057 to Permit No. 36-00465. Discharge facilities are one 6-inch diameter orifice with an invert elevation at 5.5 feet NGVD, 16 LF of 12-inch x 18-inch RCP culvert, and an existing 42-inch diameter RCP culvert. Discharge is to the adjacent 250-acre quarry lake with eventual drainage to the Imperial River.

SFWMD Permit No. 36-00466-S is issued to Mr. and Mrs. Richard Harmon for the construction and operation of a surface water management system at Harmon Photo Lab/Museum. The project area and total drainage area is 8.4 acres. The project is situated at S26/T45S/R24E. Discharge facilities include storm sewers and a detention pond that discharges via a 1-foot wide weir with a crest at elevation 8.0 feet NGVD and a top elevation at 6.17 feet NGVD. Outfall is through 300+ LF of 21-inch diameter CMP culvert to the Lake Park Drainage System. The 250-acre receiving water, does not outfall.

SFWMD Permit No. 36-00475-S is issued to F&H Enterprises for the construction and operation of a surface water management system at Park Place, a multi-family residential community. The permit pertains to 11.71 acres drainage area and a project area of 13.01 acres. A 1.3-acre wetland preserve is included in the project area. Park Place is located in S35/T45S/R24E. Permitted structures include one 0.83-foot wide weir x 0.8-foot high triangular orifice with an invert elevation at 2.5 feet NGVD, one 4.5-foot wide weir with crest elevation of 5.0 feet NGVD, and 30 LF of 15-inch diameter RCP culvert. Stormwater discharge is directed to Hendry Creek via spreader swales that sheetflow to wetlands.

SFWMD Permit No. 36-00492-S is issued to The Forest Joint Venture for the construction and operation of a surface water management system at The Oaks, a residential and recreational community. Land use includes children's park, golf course, and multi family residential. The total land area is 160 acres and the project is located in S2/T46S/R24E. The permit originally authorized a control elevation of 2.5 feet NGVD, but that was modified to 2.0 feet NGVD. Several other modifications have been authorized. Permitted structures are as follows:

North Canal: One 6.1-foot wide weir with a crest elevation of 2.5 feet NGVD, one 140-degree V-notch bleeder with an invert elevation of 1.5 feet NGVD, 18-inch diameter RCP culvert with flapgate;

Central Canal: One 4.7-foot wide weir with crest elevation of 2.5 feet NGVD, one 134-degree V-notch bleeder with invert elevation of 1.5 feet NGVD, 18-inch diameter RCP culvert with flapgate;

South Canal: One 8.3-inch wide weir with crest elevation of 2.5 feet NGVD, one 153-degree V-notch bleeder with invert elevation of 1.5 feet NGVD, 18-inch diameter RCP culvert with flapgate;

Basin I: One 1.25-foot wide weir with crest elevation of 3.0 feet NGVD, one 1.25-foot wide, 100-degree V-notch bleeder with an invert elevation 2.0 feet NGVD, 160 LF of 30-inch diameter CMP culvert and 180 LF of 30-inch diameter RCP culvert; and

Basin II: One 1.33-foot wide weir with a crest elevation of 3.0 feet NGVD, one 1.33-wide, 105 degree V-notch bleeder with an invert elevation of 2.0 feet NGVD and 250 LF of 30-inch diameter CMP culvert. The project discharges to Hendry Creek. Water quality monitoring is required by Lee County and the Southwest Florida Regional Planning Council in addition to the SFWMD.

SFWMD Permit No. 36-00515-S is issued to The Treelofts of Briarcliff for the construction and operation of a surface water management system at Laurel Oaks, a multi-family residential community. The total land area is 36.0 acres, and the project is located in S36/T45S/R24E. The surface water management system consists of grassed swales and storm water culverts to direct runoff to two water management areas, i.e., 1.5 acres of lakes and 0.6 acre of dry detention. Discharge from this site is from a control structure located at the southwest corner of the project.

The control structure consists of a 1.83-foot wide weir with a crest elevation of 8.1 feet NGVD, one 28-degree V-notch weir with an invert elevation 6.5 feet NGVD, and 315 LF of 21-inch RCP culvert leading to a roadside ditch along the east side of US 41. Final outfall is to Hendry Creek, approximately 0.25 mile north of the project.

SFWMD Permit No. 36-00516S is issued to Lennar Homes Inc. for the construction and operation of a surface water management system at Summerlin Woods, a residential development. The total land area is 20.04 acres and the project is situated in S27/T45S/R24E. Permitted structures include one special inlet with a grate at elevation 6.16 feet NGVD, one 11-inch diameter orifice with a invert elevation of 3 0 feet NGVD, and 40 LF of 24-inch diameter RCP culvert to a ditch leading to the IDD Canal, then to Hendry Creek.

SFWMD Permit No. 36-00519S is issued to Somerset Development Corporation for the construction and operation of a surface water management system at Terraverde Country Club (a.k.a. Terranova). The total land area is 60 acres, and the project is situated in S12/T46S/R24E. Permitted structures

include one 0.75-foot wide weir with a crest elevation of 3.8 feet NGVD, one triangular orifice with a top width of 4.2 feet at elevation 3.8 feet NGVD, and an invert elevation of 3.0 feet NGVD. Discharge is routed to IDD Canal "T" via 802 LF of 38-inch x 60-inch ORCP culvert, and 48 LF of 43-inch x 68 inch ORCP culvert. Ultimate outfall is to Hendry Creek.

SFWMD Permit No. 36-00529-S is issued to Galeana Realty, Inc. for the construction and operation of a surface water management system at Galeana Chrysler Plymouth. The total land area is 12.5 acres, and the project is situated in S25/T45S/R24E. A modification of the original permit authorized removal of the original control structure and construction of a new one, as follows: one 6-inch diameter bleeder with an invert elevation of 6.0 feet NGVD, and 24 LF of 12-inch x 18-inch RCP culvert. Discharge is directed to an IDD Canal via an existing ditch to Hendry Creek.

SFWMD Permit No. 36-00539-S is issued to Byer Incorporated for the construction and operation of a surface water management system for The Ashland at Lakeridge Park, multi-family residential community. The total land area is 13.9 acres, and the project is located in S26/T45S/R24E. The project area is included in Permit No 36-00057-S, Lakeridge Park Subdivision, issued to Keith Miller, Trustee, on August 10, 1978. The permit authorizes a stormwater management system consisting of grassed swales that discharge to an adjacent 250 acre quarry lake. Permitted structures include 225 LF of 18-inch diameter RCP culvert, and 25 LF of 15-inch diameter RCP culvert. Runoff is directed via inlets and culverts to a grassed retention area to the adjacent 250 acre lake. The final outfall is to Hendry Creek

SFWMD Permit No. 36-00589-S is issued for the construction and operation of a surface water management system at Bob Lincoln Oldsmobile in Fort Myers. The total land area is 12.13 total acres and the project is situated in S36/T45/R24E. The project impacts 0.047 acre of marginal wetlands. Compensating mitigation will be provided by the creation of a littoral marsh system and preservation of adjacent upland areas. Permitted structures are one 8-inch diameter orifice with invert elevation 7.5 feet NGVD, one 3-inch diameter orifice with invert elevation 4.5 NGVD, and 18 LF of 18-inch diameter RCP culvert. Discharge is directed via a marsh area, an onsite lake, into swales, to Hendry Creek.

SFWMD Permit No. 36-00591-S is issued for the construction and operation of a surface water management system at Loews South, a commercial project. The total land area is 11.0 acres and the project is situated in S36/T45/R24E. The project impacts 0.7 acre of marginal wetlands. Compensating mitigation is provided by creation of a marsh system and preservation of adjacent upland areas. Permitted structures include one 6-inch diameter orifice with invert elevation 7.5 feet NGVD, one 3-inch diameter orifice with invert elevation 4.5 feet NGVD, and 36 LF of 15-inch diameter RCP culvert. Discharge is directed via swales to an onsite marsh, to Hendry Creek.

SFWMD Permit No. 36-00609-S is issued to James P. Haggard, Southeast Developers, Inc for the construction and operation of a surface water management system at Cypress Trace - Burger King.

Previous permit modifications have been issued to others for both residential and commercial development. The permit pertains to 52.52 acres of total land area. The project is situated in S23/T45/R24E. The most recent modification authorizes one 5-inch wide weir with a crest elevation of 8.0 feet NGVD, one 6-inch diameter circular orifice with invert elevation 6.0 feet NGVD, and 30 LF of 24-inch diameter RCP, and 250 LF rock trench. Discharge is via an existing roadside ditch into Lakes Park Drainage Basin to Hendry Creek.

SFWMD Permit No. 36-00667-S is issued for the construction and operation of a surface water management system at Cypress Lake Center, a light industrial project located in S23/T45S/R24E. Permitted structures include one 10-inch diameter circular orifice with an invert elevation of 8.9 feet NGVD, with one 6-inch diameter circular orifice with an invert elevation of 6.8 feet NGVD, and 30 LF of 18-inch diameter RCP culvert. The receiving water is a former IDD Canal, then Hendry Creek.

SFWMD Permit No. 36-00719-S is issued to for the construction and operation of a surface water management system at Don Jacobs Center, a commercial project. The permit pertains to 1.79 acres water management area, and 18.12 acres of total land area. The project is situated in S26/T45/R24E. Permitted structures include one special inlet with a 0.625-foot diameter circular orifice with an invert elevation of 4.25 feet NGVD, and 50 LF of 42-inch diameter RCP culvert. A system of inlets and culverts runoff into dry detention areas which then discharge into the 1.79-acre onsite. Flows from the 42-inch discharge culvert outfall into the former IDD Canal "I-3". Next, flow is routed to the Lakes Park System and on to Hendry Creek.

SFWMD Permit No. 36-00759-S is issued to Wal-Mart Stores for the construction and operation of a surface water management system that is being modified to the increase parking lot area of a commercial building. This permit pertains to 1.63 acres of total land area, and the project is situated in S23/T45S/R23E. The originally permitted tract, 68.66 acres, was issued for the regional development known as Cypress Lake Center (Permit No. 36-00667-S. Water quality monitoring requirements for this project will be handled through the Lee County Lake Park Drainage Water Quality Monitoring Project. Permitted structures include flumes to the existing water management system. Previous discharge structures include one 7.6 inch diameter circular orifice with invert elevation 6.8 feet NGVD, 40 LF of 60 inch diameter RCP culvert. The culvert discharges into a former IDD Canal to the Lake Park Drainage area to Hendry Creek.

SFWMD Permit No. 36-01150-S is issued to Florida Coastal Developments for the construction and operation of a surface water management system at Gladiolus Improvement Center, light industrial park. This permit pertains to 0.46 acres drainage area, with total land area of 3.25 acres. Located in S26/T45S/R24E, permitted structures for this project are one 3.0-inch diameter bleeder orifice with invert elevation at 5.5 feet NGVD, one 3.0-foot wide weir with crest at elevation 8.68 feet NGVD, and 80 LF of 12-inch x 18-inch ERCP culvert. The permit was later modified to include three 4-inch bleeder pipes through berm to the west. Water is added to their retention system to help

with local runoff. Water quality monitoring is required.. Stormwater is directed via a roadside swale along Gladiolus Drive, then to Hendry Creek.

SFWMD Permit No. 36-01562-S is issued to Malcolm C. Bigger, Trustee for the construction and operation of a surface water management system at the Belle Meade Subdivision, a single family residential community. The permit pertains to 57.85 acres drainage area out of a 68.22-acre total land area. It is noted that 10.37 acres of wetland are located within the property boundary but are not considered part of the drainage area. One acre of wetland impacts and associated compensation were permitted by the Florida Department of Environmental Protection. The project is located S10/T46S/R24E. Permitted structures include one 0.85-foot diameter orifice weir with an invert elevation at 4.7 feet NGVD, and one 0.7-foot diameter orifice weir with invert elevation of 4.0 feet NGVD, and three 44-foot x 12-inch x 18 inch culverts. Discharge is directed to the wetland system to the east of the property, which connects to Hendry Creek via overland flow.

SFWMD Permit No. 36-01800-S is issued to Owners Jet Services of Illinois for construction and operation of a surface water management system at Oasis Key, a residential project. The permit pertains to 107.2 acres of total land area located in S10/T46S/R24E. The eastern portion of the site of land contains 49.4 acres wetlands and is not proposed for development. Permitted structures include one 0.42-foot broad crested weir with a crest elevation of 3.7 feet NGVD, and one 33.4-degree V-notch bleeder orifice with an invert elevation of 3.0 feet NGVD. Discharge is via the Oasis Key wetland preserve to Hendry Creek.

SFWMD Permit No. 36-02142-S is issued to Christine Partners, LTD for the construction and operation of a surface water management system at Marketplace, a retail shopping center. The permit pertains to 6.8 acres of drainage area with a total land area of 56 acres. The project is situated in S24/T45S/R24E. Discharge facilities include one 2-foot wide x 1-foot high x 90-degree triangular orifice an with invert elevation of 7 feet NGVD, 80 LF of 3-foot diameter RCP culvert, and one 5.83-foot diameter drop inlet with a crest elevation of 10.8 feet NGVD. Discharge is via a drainage swale to the former Iona Drainage Canal "I-3", then to Hendry Creek.

4.7.5.2 Agricultural Management Practices

Approximately 5% (645 acres) of the Hendry Creek Basin includes agricultural land uses (Table 4-28). Acreages of crops typically irrigated are listed for the Hendry Creek Basin in Table 4-31. Agricultural uses include crop and pasturelands and nurseries vineyard land use designations. Descriptions of permits for agricultural uses are provided below and listed in Table 4-30.

Table 4-30. Permitted surface water discharges (cfs) and groundwater withdrawals (MG) for the Hendry Creek Basin.			
Permit Number	Acres Served	Source	Allocation/Discharge
Withdrawals			
<i>36-00276-S/W</i>	20	Shallow Aquifer	156MG
Surface water discharges			
<i>36-00291-S</i>	10	-	-

Table 4-31. 1990 estimated crop acreages, irrigation types, and water use in the Hendry Creek Basin.	
CROP	ACREAGE
Improved pasture	27
Row crops	293

SFWMD Permit No. 36-00276-S/W is issued to Malcolm Biggar for Biggar Farms and extends the authorized use of groundwater from the shallow aquifer for agricultural irrigation. Twenty acres are served by a monthly withdrawal of 13 million gallons. The project is situated in S34/T45S/R24E. Withdrawal facilities include one 6 inch x 156 feet well pumped at 300 gpm. Surface water management system is for agricultural lands. Outflow is to Hendry Creek. Permitted structures are one 18 inch x 8 feet CMP discharge culvert.

SFWMD Permit No. 36-00291-S is issued to Tamiami Flower Growers, Inc. for surface water management system of agriculture lands. The permit pertains to 10 acres of total land area. The project is situated in S36/T45S/R24E. Outfall is to a local county road ditch to Hendry Creek. Permitted structures include one 18 inch (6,000 gpm) pump discharging through one 48-inch diameter x 20-foot length culvert with a flap gate.

4.8 Spring Creek

The Spring Creek Basin includes 7,350 acres in the Estero Bay Watershed in Lee County and is associated with the Spring Creek tributary to the southern half of Estero Bay. The basin extends east from Estero Bay to I-75 in the northern portion of the basin and includes most of the area south of the City of Coconut to just north of the Imperial River. S.R. 41 bisects the basin north to south and

C.R. 887 traverses the eastern half of the basin. The soils, hydrology, land use, drainage features and land use of the Spring Creek Basin are described in the following sections.

4.8.1 Topography

Elevations in the Spring Creek Basin generally range from sea level along Estero Bay and low-lying areas associated with Spring Creek to the 10 foot NGVD contour along I-75 in the western portion of the basin. Developed areas are primarily coastal and upland forests and some residential areas are located at the higher elevations to the east of S.R. 41.

4.8.2 Soils

Soils of flatwoods and sloughs dominate the Spring Creek Basin. These soils are nearly level, poorly drained, shallow to deep sandy soils. Soils along Spring Creek are deeper Immokalee-Myakka soils with an organic subsoil. Hallandale-Boca soils occur along S.R. 41 and east of it; these soils are sandier and more shallow than the Immokalee-Myakka soils. A small area of Peckish-Estero Isles soils, characteristic of tidal areas and barrier islands, occurs along the coast just north of the mouth of Spring Creek and extends north along the coast of the bay, where they are predominant in the upper basins.

In general, most of these soils are composed of the coastal Holocene sediments and undifferentiated shell beds in the interior portion of the Estero Bay Watershed. Anthropogenically altered or arent soils, e.g., dredge and fill, shell mounds, and landfills also occur in the basin.

About 15% of the soils in the basin are classified as very well-drained, well drained, to less well-drained (HSG designations A, B, and C), while 85% are classified as D (poorly drained) (Table 4-32). The drainage characteristics and associated vegetation of the soils within the Spring Creek Basin were described previously in Section 2.4. This section presents the detailed USDA/SCS soil information as compiled in a GIS database for the Estero Bay Watershed. This information has been combined with updated 1995 land use data in order to model surface water hydrology for the basin.

The majority of the individual soils series within the 7,226 acres of mapped soils in the basin have been assigned an HSG value of D (Plate 4-15). These soils total approximately 6,131 acres (Table 4-32) and make up 85% of the soils in the basin. Group D soils have very slow infiltration rates when thoroughly wetted, thus, the runoff within the basin is expected to be high. These soils are primarily clay with a high permanent water table or shallow soils over nearly impervious materials, such as a clay pan or clay layer.

The remaining soils are designated as groups A, B, and C and have low to high runoff potential. These are the more interior soils with slow infiltration rates when thoroughly wetted, often with a layer of soil that impedes the downward movement of water. These soils make up about 15% of the

soil types in the basin. A, B, and C designated soils and are generally associated with recreational land uses of residential communities such as Pelican Bay Country Club, Bonita Bay Country Club, and Bonita Spring Golf and Country Club.

Table 4-32. Hydrologic soil groups in the Spring Creek Basin.		
HYDROLOGIC SOIL GROUP	AREA (acres)	PERCENT COVER
A	38	<1%
B	343	5%
C	714	10%
D	6,131	85%
TOTAL	7,226	100%

4.8.3 Existing Land Use

Existing land use acreages for the Spring Creek Basin are presented in Table 4-33. A map of existing land use for the basin is presented in Plate 4-16. Land use classes listed in both the table and map are grouped as developed (urban and agriculture), undeveloped (natural land cover), and water. Land use is equally divided between undeveloped and developed uses in the Spring Creek Basin. Developed land use in the Spring Creek Basin covers 3,488 (47.5%) acres of the Estero Bay Watershed and is located throughout the basin. Medium density residential areas make up 635 acres (9%) of the overall land use in the basin and is located primarily west of S.R. 41. The larger residential communities include the Golf and Country Clubs of north Bonita Bay and Bonita Springs, although these communities are much more developed just south in the Imperial River Basin. Low density residential land use includes 391 acres (5%) and is located almost exclusively east of S.R. 41. Mobile homes and high density residential together make up only 4% of the basin land use and are scattered throughout the basin.

Recreation land use comprises 14% (1,030 acres) of the basin land use. Recreation land use in the basin is associated with golf and country clubs described previously, as well as the less developed areas between the lower fork of Spring Creek and Estero Bay.

The smallest land use classes are agriculture, commercial/industrial, and transportation and utilities. Agriculture makes up only 254 (3%) of the land use in the Spring Creek Basin. Agricultural use is nearly all in crop and pasture land and is located at the higher elevations in the northeastern corner of the basin. Commercial/industrial and transportation land uses combined make up less than 5% (254 acres) in the Spring Creek Basin. Transportation is associated with S.R. 41, C.R. 887, and

smaller roads, and small commercial and industrial areas are located along C.R. 887 and at its junction with S.R.41.

Nearly half the Spring Creek Basin (3,484 acres) is classified as undeveloped, and nearly a quarter of the total basin land use is in upland pine (coniferous). Upland pine forests comprise 1,659 acres (23%) and occur along and north of Bonita Bill Street to the north and east of S.R. 41.

Wetland forested areas cover another quarter of the basin overall (1,672 acres) and include large areas of wetland hardwoods (846 acres) over 12% of the basin, as well as cypress wetlands (543 acres) over another 7% of the basin. Both these classes occur along the sloughs and creeks in the basin.

Wetlands associated with the Spring Creek Basin include cypress swamps, freshwater marshes, wet prairies, melaleuca forests, and pine flatwoods. Along the creeks, the vegetation communities shift to more salt tolerant species toward the coast. Mangrove fringe wetlands and saltmarshes occur along the westernmost edges of the basin.

Water occurs primarily as reservoirs (233 acres) and sloughs (100 acres) and makes up only 353 acres (5%) of the basin. Water is primarily associated with sloughs and drainage impoundments scattered throughout the basin. These areas result in the discrepancy in total acres between soils and land use as a result of the area being designated as water in the soils map and disturbed land on the land use map.

Table 4-33. Land use and land cover in the Spring Creek Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Residential		
Residential Low Density	391	5%
Residential Medium Density	635	9%
Residential High Density	92	1%
Residential - Mobile Homes	254	3%
Subtotal	1,372	19%
Commercial/Industrial		
Commercial and Services	92	1%
Industrial	100	1%
Subtotal	192	2%
Recreation and Open Land		
Recreational	1,055	14%
Open Land	578	8%

Table 4-33. Land use and land cover in the Spring Creek Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Subtotal	1,608	22%
Transportation and Utilities		
Transportation	62	1%
Subtotal	62	1%
Agriculture		
Cropland and Pastureland	243	3%
Specialty Farms	6	<1%
Tree Crops	5	<
Subtotal	254	3%
TOTAL DEVELOPED LANDS	3,488	47.5%
Upland Forested		
Upland Coniferous Forests	1,659	23%
Upland Hardwood Forests	61	1%
Subtotal	1,720	24%
Shrub and Brushland	37	1%
Wetlands		
Wetland Coniferous Forests	543	12%
Wetland Hardwood Forests	846	7%
Vegetated Non-Forested Wetlands	225	1%
Wetland Forested Mixed	58	3%
Subtotal	1,672	23%
TOTAL UNDEVELOPED LANDS	3,429	36%
Water		
Bays and Estuaries	20	<1%
Reservoirs	233	3%
Slough Waters	100	1%
Subtotal	353	5%
TOTAL	7,350	100%

4.8.4 Geologic and Drainage Features

The Spring Creek Basin is characterized by surface and subsurface drainage features that interact with each other. There is a network of canals in the basin which provide stormwater and

groundwater drainage for residential and recreation and open areas, which make up 41% of the basin land use, while only 3% of the basin is in agriculture. Approximately 23% of the basin includes undeveloped wetlands. The existing geologic and drainage systems are discussed in the following sections.

4.8.4.1 Hydrogeology

There are three major aquifer systems underlying the Estero Bay Watershed, including the Spring Creek Basin. These are the:

- ! Surficial Aquifer System,
- ! Intermediate Aquifer System, and
- ! Floridan Aquifer System.

The Surficial Aquifer is the uppermost aquifer and includes the water table aquifer, confining beds, and the lower Tamiami aquifer; the water table aquifer and the lower Tamiami Aquifer are the two main water bearing formations. The water table aquifer is an unconfined aquifer of primarily undifferentiated sands, shell beds, calcareous clays, and some limestone. The semi-confining Tamiami confining zone separates the water table aquifer from the Lower Tamiami Aquifer.

The Surficial Aquifer is the most significant aquifer system since it is the closest to the surface and is at times in direct connection with surface water. The potentiometric surface of this aquifer follows land surface contours and for undrained areas, wet season water levels are seldom less than 3 feet above or below land surface. Variation in water levels in the basin are greatest near the coast, where water levels may vary as much as 4 feet between wet and dry seasons near Bonita Springs and variation decreases eastward.

The thickness of the Surficial Aquifer increases to about 15 feet in the easterly portions of the Spring Creek Basin. Thickness of the aquifer varies between 25 and 50 feet in central Lee County to and thickens toward the southeastern part of Lee County. Movement in the Surficial Aquifer is generally southwest and provides water for baseflow for major streams and rivers in the watershed.

A coral reef aquifer extends into southern Lee County from Collier County at shallow depths. In areas where the underlying Hawthorn confining zone is thin or absent the Surficial Aquifer is in direct hydraulic connection with the Sandstone Aquifer. The upper Hawthorn confining zone separates the Surficial Aquifer from the Sandstone Aquifer in most of Lee County. It is 0 to 25 feet below NGVD in the central portion of the basin and the thickness decreases farther south and is absent near Bonita Springs.

The Intermediate Aquifer, also called the Hawthorn Aquifer, lies below the Surficial Aquifer and is comprised of the five major units listed below. The two water producing zones of this system are the Sandstone and Mid-Hawthorn aquifers (SFWMD, 1982).

- ! Upper Hawthorn Confining Zone,
- ! Sandstone Aquifer,
- ! Mid-Hawthorn Confining Zone,
- ! Mid-Hawthorn Aquifer, and
- ! Lower Hawthorn/Tampa Confining Zone.

The Floridan Aquifer underlies all of Florida. The top of the Floridan Aquifer is associated with the lower Hawthorn Formation and the Tampa formation, the top of which ranges from -350 feet NGVD in northwestern Lee County to -700 feet NGVD in the southern portion of the county.

The Sandstone Aquifer underlies the upper Hawthorn confining zone throughout nearly the entire watershed. The top of this unit occurs between -21 and -167 feet in Lee County. In the northern part of the basin it is between -25 and -50 feet, but it dips in a southerly direction to -150 feet below the surface in the southeastern portion of Lee County.

The Tamiami and Hawthorn formations occur approximately 40-580 feet in thickness in Lee County. These formations occur as limestones and dolomites and serve as reservoirs for the Tamiami and upper Hawthorn aquifers which supply freshwater. The lower Hawthorn Aquifer water supply is highly saline. The Suwannee Limestone contains saline water (SWRPC, 1995).

4.8.4.2 Surface Drainage

The primary conveyance in the Spring Creek Basin is Spring Creek. Seven smaller tertiary basins drain mostly to Spring Creek via culverts, ditches, and swales, and eventually into southern Estero Bay. Surface drainage is dependent on groundwater levels, rainfall, and the drainage network characteristics. Groundwater inflows and rainfall are inputs to the surface water hydrologic system, whereas the drainage network controls the output. Groundwater levels were discussed in the preceding section.

4.8.5 Management Practices

Approximately 3,488 acres (47.5%) of the Spring Creek Basin are classified as urban and agricultural lands (Table 4-33). The urbanized areas of the basin are dispersed throughout the basin and many drain to roadside swales and ditches, including those along US 41, and the San Carlos drainage canal, before flowing into southern Estero Bay. The discussion of urban management practices is divided into urban water uses and urban water discharges. The water uses and water discharges are listed in the following descriptions.

4.8.5.1 Urban Management Practices

Urban water uses include public water supply, mining facilities, industrial operations, and recreational uses. Residential (1,372 acres) and recreation and open areas (1,608) make up 41% of

the total land use in the basin and water management in the basin is primarily for surface water management of these areas. Table 4-34 lists the permitted groundwater withdrawals and surface water discharges in the Spring Creek Basin. Information is from the SFWMD permit files.

Table 4-34. Permitted surface water discharges (cfs) and groundwater withdrawals (MG) in the Spring Creek Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED ANNUAL DISCHARGE/WITHDRAWAL
Surface Water Discharge			
36-00273-S	19.9	-	0.7 cfs
36-00266-S	20.0	-	8 cfs
36-00101-S	22	-	8 cfs
36-00101-S	22	-	5 cfs
36-00629-S	9.37	-	9 cfs
36-01620-S	84.37	-	130 cfs
36-00289-S	7.3	-	1.3 cfs
36-00289-S	4.8	-	1.8 cfs
Groundwater Withdrawal			
36-00186-S	1000	Lower Tamiami Aquifer	182.6 MG

Water use and surface water management permits within the basin have been issued as follows:

SFWMD Permit No. 36-00273-S is issued to Leisure Time Campsites and Club, Lee County, S16/T47S/R25E. Surface water permit is for a 19.9 acre campground. Runoff sheetflows into a 1.1 acre retention system then into a 0.55 acre lake and finally into Spring Creek via U.S. 41 road side ditch. Drainage facilities include 1-1.25" wide weir and 70 linear feet of 30" diameter culvert. A bleeder system will consist of one 75 gpm pump that will discharge the retention volume in 5 days. Design discharge is 0.7 cfs.

SFWMD Permit No. 36-00266-S is issued to the Lee County District School Board for the 20.9 acre Spring Creek Elementary School. This is a modification to a previously approved permit surface water management permit for the elementary school located north of Spring Creek and east of U.S. 41 in S21,22/T47S/R45E. The modification changes the configuration of the land , land uses remain the same as previously permitted. Drainage facilities include sheetflow into two dry detention areas, with a total acreage of 8.2 acres, berms and spreader swales surround the project site. Each detention

area has a 6" diameter bleed-down pipe, about 30 feet in length, with inlet and outlet invert elevations. Allowable discharge is 8 cfs. Discharge is to Spring Creek.

SFWMD Permit No. 36-00186-S is issued to Bonita Springs Golf and County Club, located east of Cockleshell Dr. S.E., east of old U.S. 41, north of Bonita Springs in S14/T47S/R25E.. This is a water use permit for the irrigation of 100 acres of golf course with an annual allocation of 182.6 million gallons per year. The sources of water include surface water from the project lakes and groundwater from the lower Tamiami aquifer. Wells include:

- 2 - 6 inch x 50 hp x 600 gpm surface water pumps
- 1 - 3 inch x 10 hp x 100 gpm surface water pump
- 1 - 8 inch x 63 hp x 750 gpm surface water pump
- 1 - 8 inch x 80 foot x 275 gpm well cased to 63 feet.

The permit also includes a surface water permit for 18 acres of residential land use within the 275 acre project. This permit increase the size of the existing lake by 1.68 acres and provides for an intermediate control structure at 9.0 feet NGVD. Discharge is to Spring Creek.

SFWMD Permit No. 36-00101-S is issued to Safari Campground for a surface water management system serving a 22 acre recreational and commercial land use. The project is located in Lee County west of U.S. 41 and north of Bonita Springs in S28/T47S/R25S. Drainage facilities include 1.8 acre of retention, 1-24" culvert and 1-2" wide weir, 1-6" long x 3" high bleeder slot with control elevation at 6.0 feet NGVD. Discharge is to Spring Creek. Allowable discharge is 8 cfs.

SFWMD Permit No. 36-00101-S is issued to Flordeco Inc. for the 22.0 acre Spring Creek Village project in Lee County S17/T47S/R25E. Drainage facilities include: a system of swales, inlets and culverts that collect and direct runoff to an on-site lake. The outfall structure consist of 15 ' wide concrete weir, a 8" diameter bleeder pipe set at elevation 2.0' NGVD. Allowable discharge is 5 cfs. Discharge is to Spring Creek. There is an on-site wastewater treatment system.

SFWMD Permit No. 36-00158-S is issued to Bonita Golf Club for a surface water management system serving 40.4 acres of residential lands located in Lee County S23/T47S/R25E. The system includes grassy swales, storm sewer pipe, retention lake and outfall structure discharging via a connection to Bonita Golf and County Club into Bonita Springs Drainage Ditch. Drainage facilities include: a standard type "c" inlet with overflow elevations at 12.1' NGVD, a 2" x 6" bleeder slot at 10.5' at the west end of the 2.0 acre retention pond, connected to the 24" outfall culvert. Graded roadside swales, inlets and outfall structure to the ditch with eventual discharge to Spring Creek. No allowable discharge referenced in permit.

SFWMD Permit No. 36-00629-S is issued to Bonita Shopping Center, located in Lee County S28/T47S/R25E. Project site is east of U.S. 41, immediately south of Spring Creek. This is a

surface water management permit for a 9.37 acre commercial land use. The system includes exfiltration trench and discharge structure. Drainage facilities include 3,499 linear feet of exfiltration trench with 15" diameter perforated culvert laid in 4' wide trench with 3' high rock bed. Outfall is to two dry detention areas. Discharge from northern detention area through a 1.0' high by 0.42' long v-notch orifice, 68 linear feet of 19" by 30" diameter culvert to an existing roadside ditch and Spring Creek. Allowable discharge is 9 cfs.

SFWMD Permit No. 36-00618-S is issued to San Carlos Estates Villas. This is a surface water management permit serving 77.09 acres of residential lands. Project is located in Lee County S22/T47S/25E. This is a modification to the original authorization to revise the site plan and change special conditions. The proposed system includes inlets and culverts directing discharge to on-site lakes. Drainage facilities include two on-site lakes, discharge structures with two 8" diameter bleeders and 405 linear feet of 15 " diameter culvert to the San Carlos Drainage District canal and Spring Creek.

SFWMD Permit No. 36-01620-S is issued to Development Associates for a modification of Pelican Landing Unit 4. This is a modification to an authorized surface water management system for a 289.6 acre residential tract in Lee County S16/T47S/R25E. The project is located west of U.S. 41, 3,800 feet south of Coconut Road. This permit is for a 5' wide boardwalk, 350' long with a 20' x 20' gazebo on each end. The boardwalk will meander through cypress, with 80' of the 350' crossing the Spring Creek tributary, classified as OFW. The Cypress wetland hydrologically isolated from the outfall ditch. Unit III is also included in this permit. This 84.37 acre residential tract is planned for 101 single family lots. Five sub-basins within the project. This permit addresses basins 8C which has a control elevation of 11.0' NGVD, discharge is by swale to the existing north-south ditch, then south to Spring Creek. Allowable discharges by sub-basin are: 8A- 38.20 cfs, 8B-41.88 cfs, 8C-47.02 cfs, 8D- 1.32 cfs, 8E- 1.55 cfs.

SFWMD Permit No. 36-00512-S is issued to Shannon Supply Div. of Mack Industries. This is a surface water management permit issued for a 27.6 acre industrial project in Lee County S15,22/T47S/R25E. The project is a concrete batch plant, a concrete block plant, a prestress slab manufacturing yard and related offices. Waste water treatment by septic tank. Drainage facilities include swales and culverts to a 3.0 acre dry retention area.

SFWMD Permit No. 36-00433-S is issued to Westinghouse Bayside Communities for the 9.5 acre Pelican Nest project in Lee County S20/T47S/R25E. This is a modification to an existing surface water management permit for the 9.5 acre residential land use. The modification enlarges the lake 4C to increase storage capacity, installs two throat inlets discharging from lake 4C. Discharge is to the Pelican Nest master surface water system.

SFWMD Permit No. 36-00224-S is issued to Alouette Village in Lee County S26/T47S/R25E. This is a surface water management permit for a 28 acre residential land use. Drainage facilities include

a system of inlets, culverts and roadside swales to route runoff into a detention lake and swale system where it will then outfall via a one foot wide weir to a County drainage ditch along U.S. 41.

This is a series of surface water management permits for the Bonita Bay Development located in Lee County. In total the project is 2,750 acres in size. Each permit is for a unit or phase of the overall development. For further definition of the surface water management system, a review of the master development plan is required. A summary of the issued permits is as follows.

SFWMD Permit No. 36-00289-S is issued to Bonita Bay for construction and operation of a surface water management system serving 222.5 acres of recreational land use by lakes and water control structures discharging to Imperial River and Spring Creek. Project located in Lee County S28,29/T47S/R25E.

SFWMD Permit No. 36-00289-S, a permit modification, dated April 9, 1987, for a concrete headwall with one 120 degree V-notch weir with an invert at elevation 5.0' and 160 linear feet of 42" culvert discharging to Basin C-6a. Modification in S22/T47S/R24E.

SFWMD Permit No. 36-00289-S, a permit modification dated Jan. 30, 1990, to change minimum floor elevations, S28,29,32,33,/T47S/R25E.

SFWMD Permit No. 36-00289-S, a permit modification dated September 12, 1996, to modify the surface water system serving 7.3 acres of residential land uses in S28,32/T47S/R25E. The modification includes a control structure, a 150 degree V-notch bleeder with invert elevation at 2.5", a 4.0' wide weir crest, and 130 linear feet of 24"x 38" outfall culvert. Basin discharge permitted at 0.18 cfs/acre.

SFWMD Permit No. 36-00289-S, a modification to the surface water management system serving 9.4 acres of residential, Parcel 119 in S29/T47S/R25E. The surface water management system consists of interconnected catch basins discharging to a lake which is part of the Bonita Bay Master Surface Water Management System.

SFWMD Permit No. 36-00289-S, a modification to the surface water management system serving Tract D of Bonita Bay S28/T47S/R25E. Authorizes a 0.05 acre decrease in impervious surfaces in Basin C-#-A north of Natural Area 18.

SFWMD Permit No. 36-00289-S, a modification to the surface water management system serving the Bonita Bay Information Center Parking Lot S28/T47S/R25E. The project added 11,200 s.f. of pavement to the existing parking area.

SFWMD Permit No. 36-00289-S, a modification to the surface water management system serving 0.5 acres of recreational development in S32/T47S/R25E. Project is to remove the existing 53 slip

docking facility and replace it with 27 wet slips with 15'2" width and 7 wet slip with 16'7" access width.

SFWMD Permit No. 36-00289-S, a modification to the surface water management system serving 4.8 acres residential land use in S29/T47S/R25E. Project is to connect the existing surface water management system to serve 18 units with a discharge to existing lake #80 and proposes minor reconfiguration of this lake. Permitted discharge is 0.18 cfs/acre.

SFWMD Permit No. 36-00289-S, a modification to the surface water management system serving 3.57 acres of recreational development known as Estero Bay Park S29/T47S/R25E. Drainage facilities include a natural dry upland depression which serves as a detention area. Discharge is via a 2'x3' catch basin with a 6" diameter orifice through 24' of culvert to Estero Bay.

SFWMD Permit No. 36-00289-S, a modification to the surface water management system serving a 3.98 acre residential development in S29/T47S/R25E. Project reconfigures the existing lake edge and connects to the existing surface water management system.

SFWMD Permit No. 36-00289-S, a modification to the surface water management system serving 4.13 acres of residential development known as marina Isle in S29/T47S/R25E. Stormwater runoff is routed to on-site dry retention areas prior to outfalling to Estero Bay via sheetflow.

4.8.5.2 Agricultural Management Practices

Only 3% (254 acres) of the Spring Creek Basin is occupied by agricultural land uses (Table 4-33). Estimated acres of irrigated crops include only 226 acres of improved pasturelands. Remaining agricultural uses are generally not irrigated. A single permit was found among the SFWMD permit files issued for agricultural water management in the Spring Creek Basin and is described below.

SFWMD Permit No. 36-00101-S is issued to Southall Corp. for the construction and operation of a water management system serving 28.5 acres of agricultural lands by 1-6,000 gpm pump discharging into Spring Creek. Water withdrawals are via four existing 6" shallow aquifer wells pumped at a total capacity of 640 gpm. The surface water management system allowable discharge is 1.8 cfs to Spring Creek.

4.9 Corkscrew Swamp

The Corkscrew Swamp Watershed includes 91,684 acres in the Estero Bay Watershed in Lee and Collier counties, west of the City of Immokalee and is by far the largest basin in the watershed. The soils, hydrology, land use, drainage features and land use of the Corkscrew Swamp Basin are described in the following sections.

4.9.1 Topography

Elevations in the Corkscrew Swamp Basin generally increase from the 10 foot contour along S.R. 41 in the southwest and increase in a northeasterly direction to more than 40 feet in the northern portion of the basin. The higher elevations in the most easterly portion of the basin are associated with the Immokalee Rise, and increase relatively steeply from 15 feet to over 40 feet in elevation. The Immokalee Rise also separates the drainage to the Everglades from the west coastal areas in this part of the peninsula. The Lake Trafford Basin also includes these steep rises.

In addition to the higher elevations, this basin includes the most easterly extent of the 10 foot contour. In the more northern basins, the I-75 follows the 10 foot contour, but in the Imperial River and Corkscrew Swamp basins, the lower elevations are associated with Corkscrew Swamp all the way into Collier County and to Lake Trafford.

4.9.2 Soils

Soils in the Corkscrew Swamp Basin are predominantly sands with peat accumulations in depressions, and much scattered limerock and numerous shell beds beneath the surface (Odum et al., 1976). Where rock outcrops are higher than the surrounding area, hardwoods occur over a loamy organic soil. Nowhere at Corkscrew Sanctuary is rock or shell found naturally exposed at the ground surface.

Sand deposits are the major soil type and their deposition patterns and erosion determine the area's major topographic features. The sands generally vary from tan to brown in color and are characteristically fine and thus relatively impermeable. At depths of 3 to 4 feet, the material leached from the surface forms a dark brown to black hardpan which grades into the deeper brown sands.

In wetter areas, such as low pine flatwoods and shallow marshes, the brown sands extend from the surface down to 3 to 6 feet. Peat deposits are found in mineral substrate depressions with a relatively long hydroperiod, and are characteristic of depressions. The soil profile generally consists of level layers of uniform fine sand or silty sand, varying in thickness from six inches to forty inches or more. Hallandale-Boca soils, characteristic of flatwoods and sloughs, dominate the basin. These soils are nearly level, poorly drained, shallow to deep sandy soils and sandier and more shallow than the Immokalee-Myakka soils farther west.

In general, these soils of the Corkscrew Swamp Basin are composed of the coastal Holocene sediments and undifferentiated shell beds in the interior portion of the Estero Bay Watershed. Anthropogenically altered or arent soils, e.g., dredge and fill, shell mounds, and landfills also occur in the basin.

About 2% of the soils in the basin is classified as less well-drained (HSG designation C), while 98% is classified as D (poorly drained) (Plate 4-17 and Table 4-35). The drainage characteristics and associated vegetation of the soils within the Corkscrew Swamp Basin were described previously in Section 2.4. This section presents the detailed USDA/SCS soil information as compiled in a GIS database for the Estero Bay Watershed. This information has been combined with updated 1995 land use data in order to model surface water hydrology for the basin.

Nearly all the individual soils series within the 91,633 acres of mapped soils in the basin have been assigned an HSG value of D and total 89,440 acres. Group D soils have very slow infiltration rates when thoroughly wetted, thus, the runoff within the basin is expected to be high. These soils are primarily clay with a high permanent water table or shallow soils over nearly impervious materials, such as a clay pan or clay layer. The small area of Group C soils are located in the southern most portion of the basin and appear to be associated with areas of relatively higher elevation and some upland forest.

Table 4-35. Hydrologic soil groups in the Corkscrew Swamp Basin.		
HYDROLOGIC SOIL GROUP	AREA (acres)	PERCENT COVER
A	0	0%
B	0	0%
C	2193	2%
D	89440	98%
TOTAL	91633	100%

4.9.3 Existing Land Use

Existing land use acreages for the Corkscrew Swamp Basin are presented in Table 4-36. A map of existing land use for the basin is presented in Plate 4-18. Land uses classes listed in both the table and map are grouped as developed (urban and agriculture), undeveloped (natural land cover), and water. Land use in the Corkscrew Swamp Basin includes approximately 47% developed lands, and 53% natural/undeveloped lands. Agriculture is the largest developed land use in the basin and crop and pasture lands include nearly 19% (17,828 acres) of the basin, and 24% (21,974 acres) are in tree crops.

Urban land use in the Corkscrew Swamp Basin comprises only 3% of the total land use. Residential areas make up 2% of the overall land use in the basin, including 1,105 acres (1% of the basin) of low density residential land use. The larger residential communities are located in Fort Myers (City View Park community), and others along the east side of Metro Parkway, including Plantation Pines,

Deer Run, and Highland Pines. Mobile homes and high density residential together make up only 4% of the basin land use and are scattered throughout the basin. Open lands, commercial and industrial, institutional, disturbed lands, and transportation and utilities all combined comprise about 1% of the overall land use in the basin.

Undeveloped uplands make up approximately 10% (9,573 acres) of the Corkscrew Swamp Basin and include primarily pinelands and upland hardwood forests. Wetlands make up the second largest land use class in the Corkscrew Swamp Basin, and make up 42% (38,593 acres) of the basin. Wetlands are fairly evenly divided among wetland hardwood forests, coniferous (cypress) forests, and marshes, each making up between 11 and 13% of the land use in the basin. Both these classes occur along the sloughs and creeks in the basin.

A major feature of this basin is the Corkscrew Swamp. A large portion of the basin is included in the CREW lands and most of the natural areas are under consideration for public ownership under Save Our Rivers (SOR), and CREW Trust programs.

While none of the basins have large amounts of water as a land use category, the Corkscrew Swamp Basin has the smallest percent of its basin in streams and waterways and reservoirs. The water land use category includes only 126 acres (0.1% of the basin). Water in this is primarily associated with canals and drainage impoundments scattered throughout the basin. These areas result in the discrepancy in total acres between soils and land use as a result of the area being designated as water in the soils map and disturbed land on the land use map.

Table 4-36. Land use and land cover in the Corkscrew Swamp Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Residential		
Residential Low Density	1,105	1%
Residential Medium Density	389	<1%
Residential High Density	59	<1%
Residential - Mobile Homes	62	<1%
Subtotal	1,615	2%
Commercial/Industrial		
Commercial and Services	12	<1%
Industrial	38	<1%
Institutional	23	<1%
Subtotal	73	<1%
Recreation and Open Land		
Open Land	754	1%

Table 4-36. Land use and land cover in the Corkscrew Swamp Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Subtotal	754	1%
Transportation and Utilities		
Transportation	52	<1%
Communications	64	<1%
Utilities	265	<1%
Subtotal	381	<1%
Agriculture		
Cropland and Pastureland	17,828	19%
Specialty Farms	104	<1%
Tree Crops	21,974	24%
Nurseries and Vineyards	71	<1%
Subtotal	39,977	44%
TOTAL DEVELOPED LANDS	43,319	47%
Upland Forested		
Upland Coniferous Forests	4,988	5%
Upland Hardwood Forests	3,184	3%
Herbaceous	217	<1%
Mixed Rangeland	294	<1%
Subtotal	8,683	9%
Shrub and Brushland	890	1%
Wetlands		
Wetland Coniferous Forests	10,684	12%
Wetland Hardwood Forests	10,187	11%
Vegetated Non-Forested Wetlands	11,676	13%
Wetland Forested Mixed	6,046	7%
Subtotal	38,593	42%
TOTAL UNDEVELOPED LANDS	48,166	53%
Water		
Streams and Waterways	57	<1%
Reservoirs	63	<1%
Lakes	6	<1%
Subtotal	126	<1%
TOTAL	91,684	100%

4.9.4 Hydrology and Drainage Features

Surface water in a cypress dome is closely coupled to groundwater in the underlying water table aquifer. Usually the domes are high on the water table, and water spreads radially outward from them, recharging the water table. During the dry season, farmers supplement shallow groundwater supplies from deep wells, which apparently compensate for the water drained off earlier (Odum et al., 1976). Surface water hydrology and hydrogeology of the Corkscrew Swamp Basin are described below.

4.9.4.1 Hydrogeology

The five major aquifers or producing zones in the area are listed below. They are the:

- ! Surficial Aquifer,
- ! Sandstone Aquifer,
- ! mid-Hawthorn Aquifer,
- ! lower Hawthorn/Tampa producing zone, and the
- ! Suwannee Aquifer.

The lower Hawthorn/Tampa producing zone is actually part of the Floridan Aquifer. There are also four basic types of aquifers: unconfined, confined, semi-confined, and semi-unconfined. Unconfined aquifers are composed of permeable substrates which may be partially or completely saturated with water, while a confined aquifer is completely saturated and is bounded at the top and bottom by relatively impermeable beds. Semi-confined or leaky aquifers are bounded above and below by low permeability beds. Water can move vertically through semi-confined beds. The Sandstone, mid-Hawthorn, and the individual aquifers within the Floridan Aquifer are generally termed semi-confined aquifers. The Surficial Aquifer has properties of the unconfined, semi-confined, and semi-unconfined aquifer types.

The Surficial Aquifer occurs within sediments of the Tamiami Formation and the undifferentiated deposits. The thickness of the Surficial Aquifer varies between 25 and 50 feet in central Lee County and thins east into Collier County. A coral reef aquifer also extends into southern Lee County from Collier County at shallow depths. In areas where the underlying Hawthorn confining zone is thin or absent the Surficial Aquifer is in direct hydraulic connection with the Sandstone Aquifer. The Tamiami Formation is approximately 150 feet in thickness in Collier County and forms the principal shallow aquifer in the county (SWRPC, 1995).

The Floridan Aquifer varies in thickness and underlies all of Collier County. Water from this aquifer is too salty for most purposes and is used as a supplemental supply in irrigation systems. The Hawthorn and Tampa formations overlay the Floridan Aquifer. The Hawthorn ranges from 250 to 300 feet in thickness and lower limestone of this formation are interconnected with the main body

of limestones of the Floridan. The Tampa formation is a sandy limestone with some phosphate associations in Collier County. This formation is the chief source of water yielded by flowing wells penetrating the upper part of the Floridan Aquifer.

The Sandstone Aquifer underlies the upper Hawthorn confining zone throughout the watershed. In the northern part of Lee County, the layer is between -25 and -50 feet NGVD, but it dips in a southerly direction to -150 feet in the southeastern portion of Lee County and the western portion of Collier County. The structural highs of the mid-Hawthorn Aquifer of limestones, sandstones, and dolomites also thin to the southeast around Corkscrew Swamp.

Variation in water levels in the Corkscrew Swamp Basin are approximately 1 foot and are small when compared to coastal areas, where water levels may vary as much as 4 feet between wet and dry seasons near Bonita Springs.

4.9.4.2 Surface Water Hydrology

The land surface in the Corkscrew Swamp Basin is generally a large shallow depression area that drains into Lake Trafford and ultimately into the Corkscrew Swamp. As a result of the natural depression, water collects and pools in the wetland areas for extended periods until it either percolates into the groundwater or is lost to evapotranspiration. There are no sizeable artificially constructed drainage facilities in the basin and flow is into naturally occurring wetlands.

Water flows into the Corkscrew Swamp Basin along the eastern boundary and flows out along the southern edge. At high water levels, flow along the western boundary and through a slough directly south of Lake Trafford occurs. No major canals drain the basin above the Corkscrew Swamp Sanctuary. The Corkscrew Swamp Basin is divided into 3 smaller tertiary basins, all of which drain into the swamp. Changes in timing of runoff of flows have altered the hydrology of the Corkscrew Swamp Basin. Agricultural areas around the Corkscrew sanctuary have short canals for wet season drainage, but the level terrain minimizes their effectiveness.

4.9.5 Management Practices

Approximately 43% of the Corkscrew Swamp Basin is classified as urban land (Table 4-36). The urbanized areas of the basin are dispersed throughout the basin. The discussion of urban management practices is divided into urban water uses and urban water discharges. The water uses and water discharges are listed in the following descriptions.

4.9.5.1 Urban Management Practices

Of the 43,319 acres of urban and agricultural land uses in the Corkscrew Swamp Basin, residential land use makes up 1,615 acres (2% of the total land use in the basin). Other urban water uses

include public water supply, mining facilities, industrial operations, and recreational uses. There are no permitted surface water management systems or groundwater withdrawals for residential lands in the basin, although 2 permits for commercial and industrial lands are listed (Table 4-37) and described below.

Table 4-37. Urban surface water discharges and permitted in the Corkscrew Swamp Basin.		
PERMIT NUMBER	ACRES SERVED	PERMITTED DISCHARGE
36-01901-S	75	1.2 cfs
36-01685-S	43.93	34.5 cfs

Water use and surface water management permits within the basin have been issued as follows:

SFWMD Permit No.36-01042-W is issued to Caloosa Television Corporation for the construction and operation of a water management system serving 60 acres of commercial land discharging into an existing cypress head and eventually into Corkscrew Swamp. The property is located in Lee County, within the Fakahatchee Strand basin. The radio tower facilities on the project site include 0.92 acre of impervious surface. Sixty LF of 36" RCP culvert with an invert at election 23.0' NGVD are installed at the point where the road crosses the ditch.

Permit No.36-01042-W is issued to Section 30 Limited Partnership (Corkscrew Lakes Borrow Pit) for the construction and operation of a water management system serving 640 acres of industrial lands discharging via existing roadway ditch and overland flow to Corkscrew Swamp. Discharge facilities include 1 - 4.5' wide weir with crest at 26.2' NGVD and 5 LF of 2' diameter RCP culvert, emptying into a roadside ditch. Drainage area is 640 acres. Allowable discharge is 32 cfs.

4.9.5.2 Agricultural Management Practices

Approximately 44% (39,977 acres) of the Corkscrew Swamp Basin includes agricultural land uses (Table 4-36). Agricultural uses are predominantly cropland and pasturelands and tree crops (citrus). Approximately 12,000 acres of improved pasture and row crops occur in the basin and groundwater withdrawals for the purposes of irrigation are numerous. Agricultural land use estimates for irrigated crops in the basin are listed in Table 4-38.

Permitted groundwater withdrawals in the basin are listed in Table 4-39 and summarized in the paragraphs which follow. There is a single surface water management system for the basin with a permitted discharge, listed and described below.

Table 4-38. 1990 estimated irrigated crop acreages in the Corkscrew Swamp Basin.	
CROP	ACREAGE
Improved Pasture	3,738
Row crops	8,270
Field Crops	180

Table 4-39. Permitted surface water discharges (cfs) and groundwater withdrawals (MG) for the Corkscrew Swamp Basin.			
PERMIT NUMBER.	ACRES SERVED	SOURCE	PERMITTED ANNUAL DISCHARGE/WITHDRAWAL
Withdrawals			
<i>11-00215-S/W</i>	533	Lower Tamiami Aquifer	303.7 MG
<i>11-00251-S/W</i>	40	Surficial Aquifer	27.5 MG
<i>11-00128-W</i>	3,100	Lower Tamiami and Sandstone Aquifers	1425.85 MG
<i>11-00323-S/W</i>	179	Lower Tamiami Aquifer	82.3 MG
<i>11-00324-S/W</i>	103	Sandstone Aquifer	127.63 MG
<i>36-00077-S/W</i>	200	Sandstone Aquifer	91.99 MG
<i>11-00094-S/W</i>	576.36	Sandstone and Surficial Aquifers	2570.55 MG
<i>36-00129-S</i>	253	Water table aquifer	492.1 MG
<i>11-00321-W</i>	280	Lower Tamiami Aquifer	128.79 MG
<i>36-00576-W</i>	513	Water table aquifer	235.95 MG
<i>36-01841-W</i>	36.3	Lower Tamiami Aquifer	16.7 MG
<i>36-02590-W</i>	28.7	Lower Tamiami Aquifer	23 MG
<i>36-01801-W</i>	82	Lower Tamiami Aquifer	32.72 MG
<i>36-01762-W</i>	550	Lower Tamiami Aquifer	252.97 MG
<i>11-00146-S/W</i>	38	Lower Tamiami Aquifer	29.71 MG
<i>11-00083-W</i>	35	Lower Tamiami Aquifer	16.10 MG

Table 4-39. Permitted surface water discharges (cfs) and groundwater withdrawals (MG) for the Corkscrew Swamp Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED ANNUAL DISCHARGE/WITHDRAWAL
Surface water discharges			
<i>11-00094-S/W</i>	4390	-	277 cfs

SFWMD Permit No. 11-00215-S/W is issued to Barron Collier Company for the continuation of an existing use of groundwater from 2 water table and lower Tamiami Aquifer wells for agricultural irrigation with an annual allocation of 303.07 million gallons. The total number of wells permitted is 14. The project area is located in Collier County at Sections 6, 7, 15, 22, 23/T46S/R29E. The permitted total acreage is being reduced from 2, 880 acres to 2,733 acres and the permitted total irrigated acreage is increased from 482 acres to 533 acres.

SFWMD Permit No. 11-00251-S/W is issued to Trees Unlimited Corporation, Naples Florida for the operation of a water management system serving 40 acres of agricultural lands by 1-250 gpm and 1-1,500 gpm pumps discharging into Corkscrew Swamp in addition to the continuation of an existing use of groundwater from the Surficial Aquifer for agricultural irrigation serving 40 acres with an annual allocation of 27.5 million gallons. The project area is located in Collier County, S22/T47S/R27E. The total project area is 40 acres. Permitted allowable discharge is 3 cfs and water quality monitoring is required. Groundwater facilities include 1 - 3-inch x 250 gpm electric pump and 1-20 inch pump.

SFWMD Permit No. 11-00128-W is issued to Alico Inc. (Alico Corkscrew Grove) for the continuation of an existing use of groundwater from the lower Tamiami, and the sandstone aquifers for agricultural irrigation serving 3,100 acres with an annual allocation of 1425.85 million gallons. The project area is located in Collier County, Sections 3-10, 15-22, 29, 31, and 32/T46S/R28E and has a total contiguous area of 11,402 acres of agricultural lands, 3100 of which are irrigated citrus. The permit also includes a water management system serving 8,692 acres of agricultural lands with 3 pumps discharging into Corkscrew Swamp. Withdrawal facilities include 12 - 75' x 150' x 2500 gpm sumps constructed to a depth of 6 feet below land surface and 25 -12" x 50' x 1000 gpm wells cased to 30 feet. These wells are in addition to 22 existing lower Tamiami Aquifer wells and 6 Sandstone Aquifer Wells. The site contains improved pasture lands, pine flatwoods, and approximately 192.47 acres of wetlands. The project area discharges into Cabbage Slough and then to Corkscrew Swamp.

SFWMD Permit No. 11-00323-S/W is issued to Eagle Island, Ltd. (Eagle Island Grove) in Collier County, Sections 13 - 14/T47S/R27E. The permit is for the continuation of an existing use of

groundwater from the lower Tamiami Aquifer for agricultural irrigation serving 179 acres with an annual allocation of 82.3 million gallons. Withdrawal facilities are:

- 1 - 12" x 1500 gpm well cased to 60', and
- 1 - 12" x 110' x 1500 gpm proposed well cased to 60'.

The total project area is 249 acres and 179 acres of citrus are affected by this permit. This existing permit is a modification to previous permits. The first was for the construction and operation of a water management system serving 398.4 acres of agricultural lands discharging via a spreader swale an overland flow into Corkscrew Swamp. The discharge facilities include 1 - 24" diameter drop inlet with a crest at elevation 22.4' NGVD, 40 LF of 24" diameter CMP culvert and 1500 LF of spreader swale. Water quality monitoring is required. The second was for the use of groundwater from the Surficial Aquifer for agricultural irrigation serving 315 acres of citrus with an annual allocation of 144.89 million gallons. The project area includes 50 acres of retention pond.

SFWMD Permit No. 11-00324-S/W is issued to Troyer Brothers, Inc. (Troyer Groves) in Collier County at S14/T47S/R27E. The purpose of this permit is the continuation of an existing use of groundwater from the sandstone aquifer for agricultural irrigation serving 103 acres with an annual allocation of 127.63 million gallons. The total project area is 120 acres and the total permitted irrigated acreage is 103 acres of alternating vegetable (tomatoes, potatoes). The discharge facilities include a 10 acre retention pond, 1 - 0.4 high x 0.9 wide rectangular notch with an invert at elevation 17.6' NGVD, and 35 LF of 12" diameter CMP culvert to Corkscrew Swamp via a spreader swale to the receiving land to the north. This permit is in addition to an earlier modification to decrease the retention/ detention are from 20 acres to 12 acres and increase the farm area by 8 acres. The modification also included the redesign of the overflow structure back to the farm area and an increase in pump size from 7,000 gpm to 12,000 gpm. Groundwater facilities include:

- 2 - 8 inch x 100' wells cased to 70' (to be abandoned),
- 1 - 10" x 300' x 1200 gpm well cased to 120' and pump (existing), and
- 1 - 10" x 250' x 1200 gpm well cased to 150' and pump (proposed).

SFWMD Permit No. 11-00338-S is issued to Corkscrew Nursery in Collier County at S23/T47S/R27E. The purpose of the permit is for the construction and operation of a water management system to serve 15 acres of agricultural land. Discharge is to an existing ditch north of the site and to Corkscrew Swamp. Crops consist of macadamia nuts, lyche nuts, and longans. Existing facilities include ditches, swales, a 0.52 acre retention pond, and a drainage ditch lying north of the site. Runoff from the project area will be directed to existing swales, ditches and retention pond. Discharge is via a 2 - 1.0' wide weirs with crests at elevation 21.0' 2 - 12" diameter CMP culverts to the existing drainage ditch. Permitted structures include 1 well, 1 ditch, 1 berm, and 1 off-site control structure.

SFWMD Permit No. 36-00077-S/W is issued to Alex Rosbaugh Groves, Inc, in Lee County, at S34/T46S/R27E. The permit is for the continuation of and existing use of groundwater from the Surficial Aquifer for agricultural irrigation serving 200 acres with an annual allocation of 91.99 million gallons. The permit also includes operation of a water management system serving 285 acres of agricultural lands by ditches, dikes, 1 - 30" x 10' culvert and 1 - 24" x 20' CMP discharging into Corkscrew Swamp. Water quality monitoring is required.

Withdrawal facilities are listed below.

Existing active wells

- 1 - 8 inch x 60 foot well cased to 40 feet with a 300 gpm centrifugal pump,
- 1 - 6 inch x 60 foot well cased to 40 feet with a 310 gpm centrifugal pump, and
- 1 - 6 inch x 70 foot well cased to 60 feet with a 400 gpm centrifugal pump.

Irrigation culverts

- 1 - 10' x 30" CMP, and
- 2 - 10' x 24" CMP with drop boards.

Proposed wells

- 1 - 12 inch 70 foot well with a 750 gpm centrifugal pump.

SFWMD Permit No. 11-00094-S/W is issued to Turner Corporation for the continuation of an existing use of groundwater and surface water from the Sandstone and Surficial Aquifers and an on-site reservoir for agricultural irrigation serving 2570.55 acres with a maximum monthly withdrawal of 576.36 million gallons. Location of the project is Sections 11-14, 23-24/T46S/R28E. A total of 44 (9 domestic) wells and 3 pumps are permitted. The permit also includes the operation of a water management system serving 4390 acres of agricultural lands by 2 - 20' weirs, 1 - 40,000 gpm and 1 - 2,000 gpm pumps discharging into Corkscrew Swamp via reservoir. The reservoir is 350 acres in size. Allowable discharge is 277 cfs. Water quality monitoring is required.

SFWMD Permit No. 36-00129-S is issued to SBN Grove Maintenance for the purpose of removing 610 acres from Permit No. 36-00129-S and relocating the discharge pump approximately 1,200 feet south. The 610 acres are added to Permit No. 36-02590-S. The project is located in Sections 22, 23/T46S/R27E. The purpose of *Permit No. 36-00129-S* was the continuation of the use of groundwater from the water table aquifer for agricultural irrigation serving 863 acres with an annual allocation of 492.1 million gallons. The project previously included 71 wells and 1 control structure.

SFWMD Permit No. 11-00321-W is issued to Jack M. Berry Grove for the continuation of an existing use of groundwater from the lower Tamiami aquifer for agricultural irrigation serving 280 acres with an annual allocation of 128.79 million gallons. The project is located in Lee County, S25/T46S/R27E. The permit also includes operation of a water management system serving 280

acres of agricultural lands by 2 - 24" CMP with risers and 1 - 7,500 gpm pump discharging with a permitted discharge of 18 cfs into Corkscrew Swamp. Withdrawal facilities include:

- 1 - 9-5/8" x 200' x 700 gpm well cased to 100';
- 1 - 9-5/8" x 120' x 800 gpm well cased to 84';
- 1 - 10" x 200' x 700 gpm well cased to 100'; and
- 1 - 9-5/8" x 150' x 700 gpm well cased to 67'.

SFWMD Permit No. 36-00576-W is issued to Ronald Inge for the use of groundwater from the water table aquifer for agricultural irrigation serving 513 acres of agricultural lands with annual allocation of 235.95 million gallons. Of the 640 acres of project area, 470 acres are in citrus and a cypress strand includes approximately 5.5 acres. The project area is located in Lee County, S26/T46S/R27E. The permit includes 4 wells, 1 pump, and 1 outfall. Discharge facilities include 1 -21.0" diameter drop inlet riser with a crest at elevation 26.0' NGVD and 65.0 LF of 42" diameter CCMP culvert which drains into Corkscrew Swamp via an unnamed ditch. Withdrawal facilities include:

- 1 - 10" x 140" x 1000 gpm well cased to 78 feet;
- 1 - 10" x 140" x 1000 gpm well cased to 77 feet;
- 1 - 10" x 140" x 1000 gpm well cased to 82 feet;
- 1 - 10" x 150" x 1000 gpm well cased to 77 feet;

SFWMD Permit No. 36-01841-W is issued to Paul Dinger (Dinger Grove) for the use of groundwater from the lower Tamiami Aquifer for agricultural irrigation serving 36.3 acres with an annual allocation of 16.7 million gallons. The project area is located in Lee County, S12/T46S/R27E and includes 1 pump, 2 wells and 2 outfalls. The permit also includes the construction and operation of a water management system serving 60.3 acres of agricultural lands discharging into Corkscrew swamp via a series of offsite wetlands. The discharge facility is 1-8.0" diameter circular orifice with an invert at elevation 29.0' NGVD, and 45 LF of 12" diameter CMP culvert. Withdrawal facilities include:

- 1 - 10" x 110' x 500 gpm well cased to 70', and
- 1 - 12" x 200' x 1500 gpm proposed well cased to 100'.

SFWMD Permit No. 36-02070-S is issued to Harvey and Tim Youngquist for the continued use of groundwater from the lower Tamiami aquifer for agricultural use serving 100.20 acres with an annual allocation of 109 million gallons. The current application is for an after-the-fact additional 14.8 acres of reservoir; the existing reservoir is 62.8 acres. The permit includes 1 existing well, 2 proposed wells, 1 swale, and 1 outfall structure. The project site is located in Lee County, S36/T46S/R27E. The area affected by this permit is 15.47 acres of the 243 acres of property. Discharge is into Corkscrew Swamp via a spreader swale and the discharge facility is 1 - 12"

diameter drop inlet with a crest at elevation 20.0' NGVD and 60 LF of 18" diameter CMP culvert. Withdrawal facilities include:

EXISTING 1 - 12" x 170' x 500 gpm well cased to 90 feet; and
 PROPOSED 2 - 12" x 170' x 500 gpm wells cased to 90 feet.

SFWMD Permit No. 36-02590-W is issued to Tropic Grove 2 General Partnership (c/o Smathers and Smathers) for the continued use of groundwater from the lower Tamiami aquifer for agricultural use serving 28.7 acres with an annual allocation of 23 million gallons. The property is located in Lee County, Sections 25,36/T46S/R27E. The permit also includes the construction and operation of a water management system serving 34.08 acres of agricultural lands discharging (24.03 acres of groves and a 10.05 acre reservoir) via an existing canal into Corkscrew Swamp. Withdrawal facilities include a proposed 10" x 160' x 800 gpm well cased to 80 feet. Discharge facilities include:

1 - 0.75' diameter circular orifice with invert at elevation 21' NGVD;
 50 LF of 1' diameter CMP culvert; and
 1 - 0.82' drop inlet with crest at elevation 23.4' NGVD.

SFWMD Permit No. 36-01801-W is issued to Richard and Peggy Schmidt (Schmidt Grove) for the use of groundwater from the lower Tamiami aquifer for agricultural irrigation serving 82 acres with an annual allocation of 32.72 million gallons. The property is located in Lee County, S27/T46S/R27E. Of 197 acres of the property, 82 acres are irrigated citrus. The property also includes a 32 acre reservoir, 39 acres of pine flatwoods and homesite, and 17 acres of air strip, hangar, and old pasture. Withdrawal facilities are:

3 - 10" x 110' x 1000 gpm (each) wells cased to 70'.

The permit also includes the construction and operation of a water management system serving 197 acres of agricultural lands discharging into Corkscrew Swamp via off-site wetlands. Discharge facilities include 1 - 09.5' wide weir with a crest at elevation 27.0' NGVD and 60 LF of 18" diameter CMP culvert.

SFWMD Permit No. 36-01762-W is issued to Tropic Grove General Partnership and Trop Grove 2 General Partnership (Tropic Grove) for the use of groundwater from the lower Tamiami Aquifer for agricultural irrigation serving 550 acres with an annual allocation of 252.97 MG. The total project area is 610 acres, 550 of which are irrigated, and is located in Lee County, S25/T46S/R27E. Withdrawal facilities are:

1 - 12" x 160' x 1000 gpm existing well cased to 85 feet;
 1 - 12" x 128' x 1000 gpm existing well cased to 85 feet; and
 5 - 9" x 138' x 500 gpm existing well cased to 85 feet.

SFWMD Permit No. 11-00146-S/W is issued to Harry C. McDonald for the continuation of an existing use of ground water from the Lower Tamiami Aquifer for agricultural irrigation serving 38 acres with an annual allocation of 29.71 MG. The project includes 40 acres, 30 acres of which are irrigated citrus, located in Collier County, S8/T46S/R29E. Withdrawal facilities:

existing 1 - 6" x 84' well with a 250 gpm pump, and
proposed 1 - 6" x 100' well with a 300 gpm pump.

The permit also includes operation of a water management system serving 120 acres of agricultural lands - 40 of which are the permittee's - by a 10,000 gpm pump discharging into a marsh and roadside ditch, and eventually into Corkscrew Swamp. Water quality monitoring is required. Permitted discharge for the permittee is 2.52 cfs.

SFWMD Permit No. 11-00083-W is issued to W.D. Durrance (D & D Groves) for the use of groundwater from the Lower Tamiami aquifer for agriculture serving 35 acres of the 40 acre project area, with an annual allocation of 16.10 MG. The property is located in Collier County, S3/T46S/R29E. Withdrawal facilities consist of: 1 - 8" x 84' x 500 GPM well cased to 50' and 1 - 12" x 130' x 1000 gpm proposed well cased to 120'. The permit also includes the operation of a water management system serving the 40 acres of agricultural lands by a 6,000 gpm discharging into SR 29 ditch via a drainage ditch. Water quality monitoring is required. Permitted discharge is 2.52 cfs.

SFWMD Permit No. 11-01228-S is issued to Ayala Salvadore (Ayala Farm) for the construction and operation of a surface water management system serving 50.7 acres of agricultural lands discharging to the SR 29 roadside ditch via an on-site wetland. The project site is located in Collier County, S17/T46S/R29E. The 50.7 acres of farm includes 26 acres of row crops and 4 acres of Kumquats. There are 10.0 acres of freshwater marsh and 10.7 acres of disturbed lands.

4.10 Lake Trafford

The Lake Trafford Basin includes 11,410 acres in the Estero Bay Watershed in Lee and Collier counties and is associated with Lake Trafford in the far eastern portion of the watershed, just west of the City of Immokalee, and the Camp Keais Strand to the south. The basin is bounded by S.R. 82 to the north, S.R. 29 to the east, and C.R. 846 to the east and south, and by Corkscrew Swamp to the west and northwest.

Historically, sheetflow from this area flowed south to the Cocohatchee River and into Estero Bay. But like Corkscrew Swamp and the Imperial River basins, development has altered sheetflows and flow is now east to the Imperial River.

4.10.1 Topography

Elevations in the Lake Trafford Basin are generally above the 10 foot contour that follows the perimeter of Corkscrew Swamp and Lake Trafford. The higher elevations in the northeasterly portion of the basin are associated with the Immokalee Rise, and increase relatively steeply from 15 feet to over 40 feet in elevation. The Immokalee Rise also separates the drainage to the Everglades from the west coastal areas in this part of the peninsula.

4.10.2 Soils

Soils in the Lake Trafford Basin generally consist of level layers of uniform fine sand or silty sand, varying in thickness from six inches to forty inches or more. Immokalee soils are associated with the higher areas used for agriculture, while Copeland soils occur along sloughs and the edges of Lake Trafford. The Chobee soils which are conspicuously associated with Corkscrew Swamp occur in small areas associated with Lake Trafford.

The Immokalee Rise is composed of sands in the form of relict bars and swales, which decrease in thickness to the south, east, and west, and eventually grade into Big Cypress Swamp to the east. One of the major surface peat deposits in the Estero Bay Watershed is located in the Corkscrew Swamp near Lake Trafford (Leighty et al., 1954). Smaller peat deposits occur in other swamps, marshes, ponds, and sloughs. Compared with peats of the Everglades, swamp peats of the Corkscrew Swamp are more degraded and mucky, with less conspicuous plant tissues. The condition may suggest a shorter hydroperiod, or deeper aeration zone (Stone and Gleason, 1976).

About 2% of the soils in the basin is classified as less well-drained (HSG designation C), while 90% is classified as D (poorly drained) (Plate 4-19 and Table 4-40). The drainage characteristics and associated vegetation of the soils within the basin were described previously in Section 2.4. This section presents the detailed USDA/SCS soil information as compiled in a GIS database for the Estero Bay Watershed. This information has been combined with updated 1995 land use data in order to model surface water hydrology for the basin.

Ninety percent of the individual soils series within the 9,841 acres of mapped soils in the Lake Trafford Basin has been assigned an HSG value of D and total 8,817 acres. Group D soils have very slow infiltration rates when thoroughly wetted, thus, the runoff within the basin is expected to be high. These soils are primarily clay with a high permanent water table or shallow soils over nearly impervious materials, such as a clay pan or clay layer.

This basin has a much higher percentage of Group C soils than the Imperial and Corkscrew basins in this part of the basin. The change in soils is a result of the topographic and geologic variation associated with the Immokalee Rise in the western part of the basin.

Table 4-40. Hydrologic soil groups in the Lake Trafford Basin.		
HYDROLOGIC SOIL GROUP	AREA (acres)	PERCENT COVER
A	0	0%
B	0	0%
C	1,024	10%
D	8,817	90%
TOTAL	9,841	100%

4.10.3 Existing Land Use

Existing land use acreages for the Lake Trafford Basin are presented in Table 4-41. A map of existing land use for the basin is presented in Plate 4-20. Land use classes listed in both the table and map are grouped as developed (urban and agriculture), undeveloped (natural land cover), and water. Land use in the Lake Trafford Basin includes 45% (5149 acres) developed lands, with agriculture as the primary developed land use, making up 31% (3,520 acres). Agricultural land use in the basin is almost exclusively cropland and pastureland (13%) and tree crops (16%) throughout the higher elevations in the basin and agriculture makes up the single largest land use category in the basin.

Residential areas comprise 11% (1,295 acres) of the overall land use in the basin, including predominantly low density (355 acres) and medium density (825 acres) residential. The residential communities are associated with the City of Immokalee, just outside the basin, and along the east side of Lake Trafford. Commercial and industrial, institutional, disturbed lands, recreation and open lands, and transportation and utilities combined constitute less than 3% of the land use in the Lake Trafford Basin.

Undeveloped lands make up 67% (5,319 acres) of the basin and are primarily wetlands. Upland communities in the Lake Trafford Basin make up only 13% (1,463 acres) of the basin and are primarily upland coniferous (pine) and hardwood (oak) forests. In contrast, wetland forested areas cover 28% of the basin overall (3,213 acres) and include primarily marshes (999 acres) and cypress wetlands (1,283 acres) over 20% of the basin. The marshes are associated with mixed upland forests (pine trees) at higher elevations in the northeast parts of the basin. Forested wetlands are associated with the cypress sloughs to the north and east of Lake Trafford along the southern boundary of the basin and include both the cypress wetlands and hardwood swamps (931 acres).

Interestingly, Lake Trafford is the only natural lake south of Lake Okeechobee in Florida. The lake makes up most of the water land use category in the basin (1,477 acres) and only 1% (108 acres) of

the open water is not classified as the lake. These small areas are classified as reservoir use and occur as dredged waterbodies associated with development in the eastern portion of the basin.

Table 4-41. Land use and land cover in the Lake Trafford Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Residential		
Residential Low Density	355	3%
Residential Medium Density	825	7%
Residential High Density	42	<1%
Residential - Mobile Homes	73	1%
Subtotal	1,295	11%
Commercial/Industrial		
Commercial and Services	3	<1%
Industrial	16	<1%
Institutional	16	<1%
Subtotal	35	<1%
Recreation and Open Land		
Recreational	38	<1%
Open Land	181	2%
Subtotal	219	2%
Transportation and Utilities		
Transportation	62	1%
Subtotal	62	1%
Agriculture		
Cropland and Pastureland	1,531	13%
Specialty Farms	92	1%
Tree Crops	1,811	16%
Nurseries and Vineyards	86	1%
Subtotal	3,520	31%
TOTAL DEVELOPED LANDS	5,149	45%
Upland Forested		
Upland Coniferous Forests	1,001	9%
Upland Hardwood Forests	361	3%
Herbaceous	20	<1%
Subtotal	1,382	12%
Shrub and Brushland	81	1%

Table 4-41. Land use and land cover in the Lake Trafford Basin.		
LAND USE CLASSIFICATION	AREA (acres)	PERCENT COVER
Wetlands		
Wetland Coniferous Forests	1,283	11%
Wetland Hardwood Forests	531	5%
Vegetated Non-Forested Wetlands	999	9%
Wetland Forested Mixed	400	4%
Subtotal	3,213	28%
TOTAL UNDEVELOPED LANDS	4,676	67%
Water		
Lakes	1,477	13%
Reservoirs	108	1%
Subtotal	1,585	14%
TOTAL	11,410	100%

4.10.4 Geologic and Drainage Features

The Lake Trafford Basin is characterized by surface and subsurface drainage features that interact with each other. There is a network of canals in the basin which provide stormwater and groundwater drainage for agricultural areas, which make up approximately 30% of the basin land use. Another 67% of the basin includes undeveloped lands, 30% of which are wetlands. The existing geologic and drainage systems are discussed in the following sections.

4.10.4.1 Hydrogeology

There are three major aquifer systems underlying the Estero Bay Watershed, including the Lake Trafford Basin. These are the:

- ! Surficial Aquifer System,
- ! Intermediate Aquifer System, and
- ! Floridan Aquifer System.

The Surficial Aquifer is the uppermost aquifer and includes the water table aquifer, confining beds, and the lower Tamiami aquifer; the water table aquifer and the lower Tamiami aquifer are the two main water bearing formations. The water table aquifer is an unconfined aquifer of primarily undifferentiated sands, shell beds, calcareous clays, and some limestone. The semi-confining Tamiami confining zone separates the water table aquifer from the Lower Tamiami Aquifer.

The Lake Trafford Basin includes two productive aquifers. The first is a shallow, unconfined aquifer with high transmissivity in shell beds and reef limestones known as the Coral Reef Aquifer. The second is the semi-confined Lower Tamiami Aquifer which underlies the entire area. Continued urban and agricultural development are purported to have resulted in drawdowns in both the water table and the Lower Tamiami Aquifers (SFWMD, 1995).

The Surficial Aquifer is the most significant aquifer system since it is the closest to the surface and is at times in direct connection with surface water. The potentiometric surface of this aquifer follows land surface contours and for undrained areas, wet season water levels are seldom less than 3 feet above or below land surface. The water level in the water table aquifer in the Lake Trafford Basin ranges from 4 feet NGVD in the coastal areas to 28 feet NGVD at the eastern boundary (SFWMD, 1990).

Thickness of the Surficial Aquifer varies between 25 and 50 feet in central Lee County to and thickens toward the southeastern part of Lee County. Movement in the Surficial Aquifer is generally southwest and provides water for baseflow for major streams and rivers in the watershed.

In areas where the underlying Hawthorn confining zone is thin or absent the Surficial Aquifer is in direct hydraulic connection with the Sandstone Aquifer. The upper Hawthorn confining zone separates the Surficial Aquifer from the Sandstone Aquifer in most of Lee County and ranges from 0 to 25 feet below the surface in the central portion of the watershed and the thickness decreases farther south and is absent near Bonita Springs.

The Intermediate Aquifer, also called the Hawthorn Aquifer, lies below the Surficial Aquifer and is comprised of the five major units listed below. The two water producing zones of this system are the Sandstone and Mid-Hawthorn aquifers (SFWMD, 1982).

- ! Upper Hawthorn Confining Zone,
- ! Sandstone Aquifer,
- ! Mid-Hawthorn Confining Zone,
- ! Mid-Hawthorn Aquifer, and
- ! Lower Hawthorn/Tampa Confining Zone.

The Floridan Aquifer underlies all of Florida. The top of the Floridan Aquifer is associated with the lower Hawthorn Formation and the Tampa Formation, the top of which ranges from -350 feet in northwestern Lee County to -700 feet in the southern portion of the county. The potentiometric surface of the Mid-Hawthorne Aquifer ranges from less than 20 feet NGVD at the coast to more than 50 feet NGVD along the eastern boundary of the Lake Trafford basin (SFWMD, 1990).

The Sandstone Aquifer underlies the upper Hawthorn confining zone throughout nearly the entire watershed. The Sandstone Aquifer ranges from 0 feet NGVD in the coastal portions of the Lake

Trafford Basin to 20 feet NGVD along the eastern boundary. In the northern part of the Estero Bay Watershed, the aquifer surface lies between 25 and 50 feet NGVD, but it dips in a southerly direction to 150 feet below the surface in the southeastern portion of Lee County.

The Tamiami and Hawthorn formations are approximately 40-580 feet in thickness in Lee County. The lower Hawthorn Aquifer lies between 20 and 30 feet NGVD in the Lake Trafford Basin. These formations occur as limestones and dolomites and serve as reservoirs for the Tamiami and upper Hawthorn aquifers which supply freshwater. The Lower Hawthorn Aquifer water supply is highly saline (SWRPC, 1995).

4.10.4.2 Surface Drainage

The Lake Trafford Basin is drained primarily by sheetflow drainage channels into Lake Trafford. Because of the level topography in the watershed (average slope = 0.035%; JEI, 1998), the surface drainage patterns to Estero Bay are poorly defined, with significant numbers of wetlands and relatively short, low gradient freshwater tributary streams, and surface water hydrology is influenced by overland sheetflow. As a result of development, average rainfall conditions do not result in the same sheetflow patterns as high rainfall conditions and development has also altered the boundaries by diverting flows.

Sheetflow of water historically flowed to Lake Trafford and the associated sloughs from the east and then flowed south through Camp Keais Strand to the Fakahatchee, and eventually into the Cocohatchee River. At higher water levels more characteristic of recent flows, outflows occur along the western boundary and through a slough directly south of the lake. A former high water connection with the Okaloacoochee Slough east of Lake Trafford no longer functions due to development (Odum et al., 1976).

Much of the sheetflow of water from northeast to southwest in the basin has been obstructed by a series of elevated grades and dikes in the interstate area between Corkscrew Road on the north and County Road 846 on the south (JEI, 1998). Like other interior portions of the watershed, sheetflows vary with the magnitude of storm events. Increases in magnitude and frequency fill lower areas, including Lake Trafford and Corkscrew Swamp. Once levels rise high enough, flows run west rather than south, and into the Lake Trafford Basin. As sheet flow moves southwest across the basin, it is collected by natural and artificially constructed channels and conveyed into the Estero River, Halfway Creek, Spring Creek, the Imperial River, Cocohatchee River, Corkscrew Canal, and Camp Keais Strand.

4.10.5 Management Practices

Approximately 14% of the Lake Trafford Basin is classified as urban land and 31% as agricultural (Table 4-41). The urbanized areas of the basin are dispersed throughout the basin. The discussion

of urban management practices is divided into urban water uses and urban water discharges. The water uses and water discharges are listed in the following descriptions.

4.10.5.1 Urban Management Practices

Urban water uses include public water supply, mining facilities, industrial operations, and recreational uses. No permits were found among the SFWMD permit files for surface water discharges of groundwater withdrawals for non-agricultural uses in the Lake Trafford Basin.

4.10.5.2 Agricultural Management Practices

Approximately 30% of the Lake Trafford Basin is in agricultural land uses (Table 4-41), primarily crop and pasturelands and tree crops (citrus). Estimated 1990 irrigated crop acreages in the Lake Trafford Basin are listed in Table 4-42. Permits in the basin are primarily for groundwater withdrawals for agricultural use. Agricultural land use estimates for irrigated major crops for 1990 in the basin are listed in Table 4-43 and are made up almost exclusively of improved pasture. Water use and surface water management permits within the basin are described below.

Table 4-42. 1990 estimated irrigated crop acreages in the Lake Trafford Basin.	
CROP	ACREAGE
Improved Pasture	1,238
Row crops	58

Table 4-43. Permitted surface water discharges (cfs) and groundwater withdrawals (MG) in the Lake Trafford Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED ANNUAL ALLOCATION/DISCHARGE
Withdrawals			
<i>11-00091-S/W</i>	55	Surficial and Sandstone Aquifers	25.3
<i>11-00093-S/W</i>	125	Lower Tamiami Aquifer	97.24
<i>11-00088-S/W</i>	57.5	Lower Tamiami Aquifer	44.96
<i>11-00120-W</i>	174.76	Sandstone and Surficial Aquifers	80.38
<i>11-00024S/W</i>	245	Lower Tamiami Aquifer	210.29
Surface Water Discharge			

Table 4-43. Permitted surface water discharges (cfs) and groundwater withdrawals (MG) in the Lake Trafford Basin.			
PERMIT NUMBER	ACRES SERVED	SOURCE	PERMITTED ANNUAL ALLOCATION/DISCHARGE
11-00088-S/W	57.5	-	4.42 cfs

SFWMD Permit No. 11-00596-S is issued to Jack Queen Construction, Inc for a surface water management system designed to collect and convey excess runoff from Queen Grove. Located in S17/T46S/R29E, the total land area is 25.5 acres. Stormwater runoff will be directed via internal collector swales designed to collect and convey excess runoff from a 23.9 acre grove and direct it to a 1300 gpm pump proposed to pump the runoff into a 1.6-acre above ground reservoir, with eventual discharge to Lake Trafford. Discharge from the reservoir is through a control structure consisting of a 4.0 inch diameter bleeder orifice with invert set at elevation 38 feet NGVD, a weir with crest elevation at 43 feet NGVD, and 40 LF of 12 inch diameter CMP culvert. A proposed overflow structure from the reservoir to the grove consists of an 18 inch diameter riser with a crest elevation at 43.0 feet NGVD.

SFWMD Permit No. 11-00091-S/W is issued to R.A. Bethea, Jr. of R.A. Bethea, Jr. Groves, for the continuation of an existing use of groundwater from the surficial and sandstone aquifers for agricultural irrigation serving 55 acres with an annual allocation of 25.3 million gallons, and includes a water use permit and renewals, as well as multiple phases of a surface water permit. Located in Collier County, the project is situated in S7/T46S/R29E. The source of groundwater is the sandstone aquifer, and surface water from the Surficial Aquifer system. Of a total land area of 70 acres, the irrigated area affected by this permit is 55 acres. The permitted annual allocation of irrigation water is 25.3 million gallons. Groundwater facilities include 1 - 10-inch x 250 foot x 800-1000 gpm wells cased to 190 feet, and 1 - 6 inch x 70 foot x 500 gpm existing well cased to 60 feet.

SFWMD Permit No. 11-00093-S/W is issued to Anthony Rosbough (Anthony Rosbough Estates) for the continuation of an existing use of groundwater from the lower Tamiami Aquifer for agricultural irrigation serving 125 acres with an annual allocation of 97.74 million gallons in addition to the operation of a water management system serving the agricultural lands by 1-24 inch CMP discharging into Lake Trafford via a drainage ditch. Located in Collier County, the project is situated in S7/T46S/R29E. Of a total land area of 131 acres, the irrigated area affected by this permit is 125 acres of citrus. The permitted annual allocation of irrigation water is 97.74 million gallons. Groundwater facilities include 2 - 6 inch x 60 foot x 350 gpm wells cased to 60 feet. Water quality monitoring is required.

SFWMD Permit No. 11-00088-S/W is issued to William Leinweber for the continuation of an existing use of groundwater from the lower Tamiami Aquifer for agricultural irrigation serving 57.5 acres with an annual allocation of 44.96 million gallons. Located in Collier County, the project is

situated at S7/T46S/R29E and total project area is 70 acres of citrus. Groundwater facilities include 1 - 4 inch x 60 foot x 300 gpm well cased to 60 feet. In addition to the well, the permittee has an allowable permitted discharge of 4.42 cfs and water quality monitoring is required.

SFWMD Permit No. 11-00120-W is issued to Bob Paul, Inc. of Barfield Grove in Labelle, Florida. The project area is located in Sections 18 and 19/T46S/R29E. The permit is for the purpose of withdrawing groundwater from the sandstone and surficial aquifer for agriculture. The project area is 245.83 acres and the area affected by this permit is 174.76 acres of citrus with an annual allocation of 80.38 million gallons. Withdrawal facilities are:

- 1 - 8 inch x 80 foot x 450 gpm wells,
- 1 - 8 inch x 80 foot x 250 gpm wells,
- 1 - 8 inch x 80 foot well (currently inactive), and
- 1 - 12 inch x 210 foot x 500 gpm well cased to 150 feet.

SFWMD Permit No. 11-00024S/W is issued to the University of Florida (Southwest Florida Research and Education Center) in Immokalee, Florida. The project area is located in S20/T46S/R29E. The permit is for the continuation of and existing use of groundwater from the lower Tamiami aquifer for agricultural irrigation serving 245 acres with an annual allocation of 210.29 million gallons. The project area is 320 acres and the area affected by this permit is 245 acres of irrigated crops. The crop acreages are:

- 70 acres citrus,
- 20 acres vegetables,
- 40 acres sugarcane, and
- 115 acres of improved pasture.

Withdrawal facilities are:

Existing active wells

- 2 - 8 inch x 100 foot wells cased to 60 feet with a 500 gpm and a 650 gpm turbine pump,
- 1 - 6 inch x 97 foot well cased to 60 feet with a 150 gpm pump, and
- 1 - 6 inch x 93 foot well cased to 60 feet with a 150 gpm turbine pump.

Existing inactive wells

- 1 - 6 inch x 100 foot well cased to 60 feet with a 300 gpm turbine pump, and
- 1 - 6 inch x 80 foot well cased to 60 feet with a 350 gpm turbine pump.

Proposed wells

- 1 - 12 inch x 120 foot well cased to 60 feet with a 800 gpm turbine pump,
- 1 - 12 inch x 120 foot well cased to 60 feet no pump specified, and

2 - 100 foot wells no pump specified.

4.11 Barrier Islands

The Barrier Islands Basin includes 15,726 acres in the northern portion of Lee County and drains the barrier islands into Estero Bay and the Estero Bay Aquatic Preserve to the east and the Gulf of Mexico to the west. A portion of the Islands themselves is included in the Estero Bay State Buffer Preserve. Estero Island lies north of Big Carlos Pass and includes the city of Fort Myers Beach. South of the pass the islands are made up of several small islands, including Black Island, Long Key, and Big Hickory Island, separated by New Pass and Big Hickory Pass. The city of Bonita Beach is located along the southern portion of the islands where they are nearly connected to the mainland. County Road 865 (Bonita Beach Road) travels to and from the mainland via the length of the islands.

4.11.1 Topography

Elevations in the Barrier Islands Basin are below the 5 foot elevation contour and are generally below the 1 foot contour. Elevations increase slightly from the southern islands to Estero Island.

4.11.2 Soils

Soils in the Barrier Islands Basin are characteristic of tidal areas and barrier islands. These soils are nearly level, somewhat poorly drained to very poorly drained and many are sandy throughout with a mixture of shell fragments. Others have a thin mucky surface layer or are organic to a depth greater than 16 inches. These soils include Wulfert-Kesson-Captiva, Peckish-Estero-isles, and Canaveral-Captiva-Kesson soils. Soil units on the barrier islands which have not been identified because they are more than 85% developed are mapped as “urban” and are the dominant soil unit along Estero Island, south to Big Carlos Pass. Soils with less than 12 inches of fill are not considered as spoil or fill and none of the map units along the barrier islands include these soils or the anthropogenic Matlache soils of spoil islands.

Nearly all the individual soils series within the basin have been assigned an HSG value of D and total 3,603 acres, making up 84.74% acres of the total 4,252 acres of soils and 23% of the total basin (Table 4-44). Group D soils have very slow infiltration rates when thoroughly wetted, thus, the runoff within the basin is expected to be high. These soils are primarily clay with a high permanent water table or shallow soils over nearly impervious materials, such as a clay pan or clay layer. The small area of Group C soils are located on either side of Big Carlos Pass and along that portion of Bonita Beach Boulevard in the southern most portion of the basin. Soils are mapped for the basin in Plate 4-21.

Table 4-44. Hydrologic soil types in the Barrier Islands Basin.		
SOIL TYPE	ACRES	PERCENT
A	0	0
B	0	0
C	649	4%
D	3,603	23%
TOTAL	15,726	100%

4.11.3 Existing Land Use

Existing land use acreages for the Barrier Islands Basin are presented in Table 4-45. A map of existing land use for the basin is presented in Plate 4-22. Seventy-one percent of the area in the basin (11,025 acres) is classified as bay and estuaries, leaving a total of 15% developed lands (urban and agriculture land uses) and 14% undeveloped lands. If bays and estuaries are removed from the land use, however, there are only 4,701 acres in the basin, and 54% are developed lands.

Of the 4,701 acres of the basin not classified as bay or estuary, about 42% are wetland hardwood forests and 22% are medium density residential. Transportation, commercial, high density residential, recreation, and disturbed lands make up almost all of the remaining lands. There is no agriculture in the basin.

Basin-wide, including the bay and estuary, residential areas make up 7% (1,055 acres) of the overall land use in the basin, and are predominantly medium density (762) and high density (155 acres) residential. The larger residential communities are located in Fort Myers Beach, on the northern Estero Island, and Bonita Beach on the lower island. Mobile homes and low density residential together make up less than 2% of the basin land use and are scattered throughout the basin.

Recreation land use makes up 2% (265 acres) of the basin land use. Recreation land use in the basin is associated primarily with parks and golf courses. These include parks on Estero Island and the Carl E. Johnson County Park on Long Key, south of Big Carlos Pass, Mound Key State Park, and the Bay Beach Golf Course at the tip of Estero Island.

Commercial/industrial and transportation land uses combined compose 4% (712 acres) of the Barrier Islands Basin. Commercial land use is associated with small business areas on Estero Island and C.R. 865 travels the length of the basin. Less than 14% of the Barrier Islands Basin (2,185 acres) is classified as undeveloped, and most of it is classified as wetland hardwood forests. Wetland hardwood forests in the basin are located almost exclusively on the lower islands and those on Estero Island are associated with the parks and golf course.

Disturbed lands (360 acres) make up 2% of the basin overall and nearly 8% of the basin exclusive of bays and estuaries. The disturbed areas are located on Black Island, just south of Big Carlos Pass, and make up that portion of Mound Key not occupied by the Mound Key State Park. Water other than bays and estuaries make up only about 1% of the land use in the basin. These waters are classified primarily as streams and waterways (74 acres) and sloughs (20 acres) and occur often as canals.

Table 4-45. Land use and land cover for the Barrier Islands Basin.		
LAND USE CLASSIFICATION	ACRES	PERCENT
Residential		
Residential - Mobile Homes	93	1%
Residential Low Density	45	<1%
Residential Medium Density	762	5%
Residential High Density	155	1%
Subtotal	1,055	7%
Commercial and Industrial		
Commercial and Services	489	3%
Industrial	19	<1%
Subtotal	508	3%
Institutional	23	<1%
Recreation and Open Lands	265	2%
Barren/Disturbed Lands	360	2%
Transportation and Utilities	204	1%
Agriculture	0	0
TOTAL DEVELOPED LANDS	24,141	15%
Upland Forested		
Upland Coniferous Forests	1	<1%
Upland Hardwood Forests	15	<1%
Subtotal	16	<1%
Wetlands		
Wetland Hardwood Forests	1,949	12%
Wetland Non-vegetated	191	1%
Vegetated Non-Forested	29	<1%
Subtotal	2,169	13%
TOTAL UNDEVELOPED LANDS	2,185	14%
Water		
Streams and Waterways	74	<1%

Table 4-45. Land use and land cover for the Barrier Islands Basin.		
LAND USE CLASSIFICATION	ACRES	PERCENT
Bays and Estuaries	11,025	70%
Slough Waters	20	<1
Lakes	8	<1%
Subtotal	11,127	71%
TOTAL	15,726	100%

4.11.4 Geologic and Drainage Features

The Barrier Islands Basin is characterized by surface and subsurface drainage features that interact with each other, as well as anthropogenic features associated with the large urban areas in the basin. There is a network of canals in the basin which provide stormwater and groundwater drainage for residential areas, which make up more than 50% of the land use in the basin (exclusive of the bay and estuary). The existing geologic and drainage systems are discussed in the following sections.

4.11.4.1 Hydrogeology

There are three major aquifer systems underlying the Estero Bay Watershed, including the Barrier Islands Basin. These are the:

- ! Surficial Aquifer System,
- ! Intermediate Aquifer System, and
- ! Floridan Aquifer System.

The Surficial Aquifer is the uppermost aquifer and includes the water table aquifer, confining beds, and the lower Tamiami aquifer; the water table aquifer and the lower Tamiami aquifer are the two main water-bearing formations. The water table aquifer is an unconfined aquifer of primarily undifferentiated sands, shell beds, calcareous clays, and some limestone. The semi-confining Tamiami confining zone separates the water table aquifer from the Lower Tamiami Aquifer.

The Surficial Aquifer is the most significant aquifer system since it is the closest to the surface and is at times in direct connection with surface water. The potentiometric surface of this aquifer follows land surface contours and for undrained areas, wet season water levels are seldom less than 3 feet above or below land surface (SFWMD, 1990). Movement in the Surficial Aquifer is generally southwest and provides water for baseflow for major streams and rivers in the basin.

In areas where the underlying Hawthorn confining zone is thin or absent the Surficial Aquifer is in direct hydraulic connection with the Sandstone aquifer. The upper Hawthorn confining zone separates the Surficial Aquifer from the Sandstone Aquifer in most of Lee County and ranges from

0 to 25 feet below the surface in the central portion of the watershed and the thickness decreases farther south and is absent near Bonita Springs.

The Intermediate Aquifer, also called the Hawthorn Aquifer, lies below the Surficial Aquifer and is comprised of the five major units listed below. The two water producing zones of this system are the Sandstone and Mid-Hawthorn aquifers (SFWMD, 1982).

- ! Upper Hawthorn Confining Zone,
- ! Sandstone Aquifer,
- ! Mid-Hawthorn Confining Zone,
- ! Mid-Hawthorn Aquifer, and
- ! Lower Hawthorn/Tampa Confining Zone.

The Floridan Aquifer underlies all of Florida. The top of the Floridan Aquifer is associated with the lower Hawthorn Formation and the Tampa Formation. The Sandstone Aquifer underlies the upper Hawthorn confining zone throughout nearly the entire watershed. The top of this unit occurs between 10 to 15 feet NGVD along the coastal areas. The Tamiami and Hawthorn formations are approximately 40-580 feet in thickness in Lee County. These formations occur as limestones and dolomites and serve as reservoirs for the Tamiami and upper Hawthorn aquifers which supply freshwater. The lower Hawthorn Aquifer water supply is highly saline (SWRPC, 1995).

The thickness of the lower Hawthorne confining bed is greatest along the central barrier islands (400 ft) and decreases both north and south to 250 - 300 feet. The potentiometric surface of the water table aquifer along the length of the barrier islands is less than 4 feet NGVD. The water level in the Sandstone Aquifer is estimated at less than 5 feet, and the Lower Hawthorne at about 30 feet NGVD.

4.11.4.2 Surface Drainage

Surface drainage is dependent on groundwater levels, rainfall, and the drainage network characteristics. Groundwater inflows and rainfall are inputs to the surface water hydrologic system, whereas the drainage network controls the output. Sheetflow is the primary means in the Barrier Islands Basin, and flow is either directly into the Bay or Gulf, or into residential canals before entering the Bay or Gulf.

4.11.5 Management Practices

Approximately 59% of the Barrier Islands Basin is classified as urban and agricultural lands (Table 4-45). The urbanized areas of the basin are dispersed throughout the basin. The discussion of urban management practices is divided into urban water uses and urban water discharges. The water uses and water discharges are listed in the following descriptions.

4.11.5.1 Urban Management Practices

Basin-wide, a total of 15% is developed in the Barrier Islands Basin, none of which is agriculture land. Excluding bays and estuaries, there are only 4,701 acres in the basin, and 54% of these are developed, and 22% are medium density residential. Transportation, commercial, high density residential, recreation, and disturbed lands make up almost all of the remaining urban lands.

Although there are permitted surface water discharges in the basin, volumes of discharges are not specifically listed in the permits. Accordingly, water management features are summarized below. Information was obtained from SFWMD permit files.

SFWMD Permit No. 36-01233-S issued to Ocean Harbour, a 8.95 acre residential land use located in Lee County S28/T45S/R24E. This surface water management system consist of swales which direct excess runoff through a series of dry retention areas. The outfall structures consists of a 10.0" wide vertical slot with an invert at elevation 3.1' NGVD and a 3.0" diameter circular bleeder with an invert at elevation 2.5' NGVD. Outfall is to Estero Bay via a spreader swale.

SFWMD Permit No. 36-01194-S issued to Fish Tail Marina, a 5.76 acre commercial/industrial land use located in Lee County S3/T47S/R24E. The surface water management system consists of a series of catch basins which direct excess runoff to a centrally located dry retention area. An outfall structure consists of a 3.0" diameter bleeder orifice with an invert at elevation 2.5' NGVD and 60 LF of 24" culvert. Outfall from the structure is to Estero Bay via a man made canal.

SFWMD Permit No. 36-01605-S issued to the State of Florida Department of General Services for the Lovers Key State Recreational Area located in Lee County S11/T47S/R24E. This is a surface water management system serving a 19.65 acre recreational facility within 500 acres discharging to the Gulf of Mexico. The drainage facilities include grassed berms which overtop when the water level reaches 4.5' NGVD.

4.11.5.2 Agricultural Management Practices

There is no agriculture in the Barrier Islands Basin.